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Callistemon pungens
Lumley & R.D. Spencer
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Callistemon pungens is a distinctive pungent-leaved bottlebrush from the New South Wales Northern Tablelands and the Darling Downs region of Southern Queensland. Before being formally described botanically it was cultivated for its attractive lilac stamens and known by the names *Callistemon* 'Gilesii' and *Callistemon* 'Lana'.

Muelleria publishes research papers on Southern Hemisphere plant, algal and fungal taxonomy and systematics, particularly relating to Australia. Acceptable submissions include: taxonomic revisions; phylogenetic and biogeographical studies; short papers describing new taxa, documenting nationally significant new records, or resolving nomenclatural matters; historical analyses relevant to systematics; and any research contributing to our knowledge of plant, algal or fungal diversity. Special issues or reviews will also be considered after discussion with the Editor.

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Typification of infrageneric taxa in *Dendrobium* (Orchidaceae)

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Introduction

The nomenclature of infrageneric taxa in Orchidaceae on occasion borders on the chaotic. In the past, names were often proposed in a highly informal fashion, with little concern for typification, priority, precise circumscription, or even ranking. Such names were frequently applied to sets of species which had little in common beyond one or a few key characters. Those who used these names rarely cited their authors, while the circumscription of the taxa often varied considerably from one botanist to the next. It was not uncommon that earlier names were deliberately disregarded, to be replaced with new names that more or less covered the same groups. As a result, the nomenclature and systematics of many infrageneric taxa were, and sometimes still are, extremely confused.

In *Dendrobium*, one of the largest orchid genera with some 1500 species (Pridgeon *et al.*, in prep.), well over 200 subgenera, sections and subsections have been proposed. Examples of all the problems just mentioned can be found in abundance in this gargantuan taxon. Fortunately, many of these problems can be solved rather easily by carefully typifying the taxa involved. The International Code of Botanical Nomenclature (McNeill *et al.* 2005) includes two provisions that in certain cases make this process almost automatic:

1. "If in the protologue of the name of a genus or of any subdivision of a genus the holotype or lectotype of one or more previously or simultaneously published species name(s) is definitely included, the type must be chosen from among these types unless the type was indicated or designated by the author of the name." (Article 10.2) As a result, when an infrageneric taxon was initially proposed with only a single member species, then that species is automatically the type species of that taxon.
2. "When the epithet in the name of a subdivision of a genus is identical with or derived from the epithet of one of its constituent species, the type of the name of the subdivision of the genus is the same as that of the species name, unless the original author of the subdivisional name designated another type." (Article 22.6) Thus, for example, *Dendrobium nobile* Lindl. should be the type of section *Nobilia* (Pfitzer)

Abstract

In order to stabilise the nomenclature of infrageneric taxa in *Dendrobium*, type species are chosen for those taxa for which this has not been done previously. In all, 35 names are typified, including one genus name (*Onychium*), and assigned to sections of *Dendrobium* as recognised in *Genera Orchidacearum*.

Keywords: *Dendrobium*, infrageneric taxa, nomenclature, taxonomy

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Kraenzl. Presumably, when taking Article 10.2 into consideration, Article 22.6 only applies to species mentioned in the protologue by the original author of the subdivision. The extent to which an epithet can be termed 'derived' is not entirely obvious, since in Example 7 to Article 22.6, *Plantago* sect. *Oliganthos* is said to be derived from *P. pauciflora*, as the epithets share the same meaning. Does this imply that *Dendrobium* subsect. *Camptocentra* is derived from *D. hamatum*? Or is *Dendrobium* sect. *Angustifolia* derived from *D. bambusifolium*? In both, and similar, cases, I have decided that the derivation is not obvious enough, but there is clearly room for debate over this.

Over the years, most infrageneric taxa in *Dendrobium* have been typified. Sometimes the typifications were in conflict with these provisions, as for example when Brieger (1981) typified *Dendrobium* section *Eleutheroglossum* Schltr. with *Dendrobium canaliculatum* R.Br., while by Article 22.6 he should have chosen *D. eleutheroglossum* Schltr. Such mistakes are mostly easily remedied, however. There still remain some 35 taxa that have never been typified and where typification is not automatic. As at least some of these taxa are clearly polyphyletic according to current insights, typification is necessary to prevent nomenclatural problems in the future. The typifications that are proposed below were made with the following principle in mind:

Wherever possible and desirable, a type is to be chosen such that the newly typified taxon (NTT) will have the same type as an earlier taxon at the same rank. This is to ensure that the NTT will be an easily recognised synonym, and will not take precedence over another, later taxon, which may be or may have been in common use.

For instance, I have typified *Dendrobium* sect. *Onychium* Blume with *Onychium japonicum* Blume (= *D. moniliforme* (L.) Sw.). As a result, sect. *Onychium* reduces to a synonym of *Dendrobium* sect. *Dendrobium*, because *D. moniliforme* is the type species of *Dendrobium*. Had I chosen *Onychium crumenatum* (Sw.) Blume as the type species, then sect. *Onychium* would have gained priority over the frequently used later section name *Crumenata*. In the same way, another choice could have caused either sect. *Calcarifera*, sect. *Distichophyllae* or sect. *Platycaulon* to become a synonym of sect. *Onychium*.

A well-supported infrageneric classification of *Dendrobium* is not yet available. Below I have indicated, between square brackets, the dispositions of the infrageneric taxa in question according to the forthcoming treatment in *Genera Orchidacearum* vol. 6 (Pridgeon *et al.*, in prep.), which is still to a considerable extent tentative and likely to be modified in light of future studies. In this treatment, a broad view of the genus is taken; DNA evidence indicates that in this view *Dendrobium* is a monophyletic group (Adams 2011; Schuiteman 2011; Schuiteman and Adams 2010). It is outside the scope of this article to circumscribe the sections adopted here; I refer to *Genera Orchidacearum*. In a few cases where the content of the sections differs significantly from traditional usage this is indicated in a note.

It will be seen that all names listed below are reduced to synonymy. However, some of the taxa at the rank of subsection may well become relevant in the future, as they will have priority at that rank.

This paper contains no new synonyms at species level. Species synonymy follows Govaerts (2011).

Typifications

***Dendrobium* sect. *Angustifolia* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 165 (1910).** Type species: *Grastidium salaccense* Blume = *Dendrobium salaccense* (Blume) Lindl. (here chosen) [= *Dendrobium* sect. *Grastidium* Blume]

Note – Kraenzlin cited this section as '*Angustifolia s.* [= *sive*] *Bambusacea*'. Possibly, the epithet *Bambusacea* is a misspelling of Ridley's section *Bambusifoliae*.

***Dendrobium* sect. *Bambusifoliae* Ridl., *Mat. Fl. Malay Penins.* 1: 31 (1907) (as '*Bambusaefoliae*').** Type species: *Dendrobium gemellum* auct. non Lindl.: Ridl. (p.p.) (= *D. salaccense* (Blume) Lindl.) (here chosen; see note) [= *Dendrobium* sect. *Grastidium* Blume]

Notes – In the protologue Ridley did not list *D. bambusifolium* Parish & Rchb.f. (a synonym of *D. salaccense* (Blume) Lindl.) among the species that he included in this section, although he may have had this species in mind when he invented the name. Section names like *Bambusifoliae*, *Foliosae*, *Distichophyllae*, etc., are not to be altered to *Bambusifolia*, *Foliosa*, etc, as they are not declensions of *Bambusifolium*, etc. (in which case they would be contrary to ICBN Article 21.2),

but rather arbitrarily composed names in the sense of ICBN Article 20.1. As noted by Holttum (1953), Ridley misapplied the name *D. gemellum* Lindl. to the species now called *D. salaccense* (Blume) Lindl., as well as to the closely related *D. indragiriense* Schltr. This is probably due to the fact that Lindley himself had mistakenly identified specimens of *D. salaccense* in his herbarium as *D. gemellum*. The true *D. gemellum*, which was based on *Pedilonum biflorum* Blume, does not belong in this section, but to sect. *Pedilonum* (or sect. *Calcarifera* in older classifications).

***Dendrobium* sect. *Brachyanthe* Schltr., *Repert. Spec. Nov. Regni Veg. Beih.* 1: 446 (1912).** Type species: *Dendrobium bicameratum* Lindl. (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Glomerata* subsect. *Brachycentra* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 101 (1910).** Type species: *Dendrobium minahassae* Kraenzl. (= *D. heterocarpum* Wall. ex Lindl.) (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Eudendrobium* subsect. *Calvae* Lindl., *J. Proc. Linn. Soc.*, Bot. 3: 14 (1859).** Type species: *Dendrobium breviflorum* Lindl. (= *D. bicameratum* Lindl.) (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Glomerata* subsect. *Camptocentra* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 101 (1910).** Type species: *Dendrobium epidendropsis* Kraenzl. (= *D. ionopus* Rchb.f.) (here chosen) [= *Dendrobium* sect. *Pedilonum* Blume]

Notes – The type species of this subsection is a synonym of the type of subsect. *Macrocentra*. Section *Pedilonum* is here taken in the expanded sense as adopted in Genera Orchidacearum, which includes many, but by no means all, species formerly treated as members of sect. *Calcarifera*, such as *D. ionopus*. See also the note under sect. *Capitata*.

***Dendrobium* sect. *Capitata* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 130 (1910).** Type species: *Dendrobium purpureum* Roxb. (here chosen) [= *Dendrobium* sect. *Calyptrochilus* Blume]

Note – Section *Calyptrochilus* is here taken in the expanded sense as adopted in Genera Orchidacearum, which includes many, but by no means all, species formerly treated as members of sect. *Pedilonum*, such as *D. purpureum*. See also the note under subsect. *Camptocentra*.

***Dendrobium* sect. *Eudendrobium* subsect. *Chrysostachya* Pfitzer in Engl. & Prantl, *Nat. Pflanzenfam.* II, 6: 173 (1889).** Type species: *Dendrobium fimbriatum* Hook. (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Desmotrichum* Blume, *Tab. Pl. Jav. Orchid.* (1825) in Clavis Generum (nom. rej.).** Type species: *Desmotrichum angulatum* Blume = *Dendrobium barbatum* Breda (here chosen) [= *Dendrobium* sect. *Crinifera* Pfitzer]

Note – Since *Desmotrichum* (Blume) Blume is a nomen rejiciendum (ICBN Article 56.1), its implicit basionym (ICBN Article 33.3) *Dendrobium* sect. *Desmotrichum* Blume, is also a nomen rejiciendum.

***Dendrobium* sect. *Dianthe* Schltr. in K.Schum. & Lauterb., *Nachtr. Fl. Deutsch. Schutzgeb. Südsee* 150 (1905).** Type species: *Dendrobium gemellum* auct. non Lindl.: Ridl. (p.p.) (= *D. salaccense* (Blume) Lindl.) (here chosen) [= *Dendrobium* sect. *Grastidium* Blume]

Note – Schlechter (l.c.) writes that his section *Dianthe* could be regarded as an expanded version of Ridley's section *Gemella*. I have been unable to find a publication by Ridley in which that section is mentioned, and consider it a manuscript name. However, this reference to a section *Gemella* demonstrates that Schlechter included *Dendrobium gemellum* auct. non Lindl.: Ridl. in his section *Dianthe*, and this species is also mentioned in the protologue as *D. gemellum* Lindl. Evidently, Schlechter, like Ridley, at that time misinterpreted *D. gemellum* (see note under sect. *Bambusifoliae*).

***Dendrobium* sect. *Stachyobium* subsect. *Elatiores* Benth. & Hook.f., *Gen. Pl.* 3: 500 (1883).** Type species: *Dendrobium barbatulum* auct. non Batem.: Wight = *Dendrobium ovatum* (L.) Kraenzl. (here chosen) [= *Dendrobium* sect. *Fytchianthe* Schltr.]

Note – Hooker (1890) listed *D. barbatulum* auct. non Batem.: Wight as a synonym under *D. chlorops* Lindl., which, in turn, is a synonym of *D. ovatum*.

***Dendrobium* sect. *Eudendrobium* Lindl., *Paxton's Fl. Gard.* 1: 134 (1850-51) (nom. illeg.; ICBN Art. 21.3).** Type species: *Epidendrum moniliforme* L. = *Dendrobium moniliforme* (L.) Sw. (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Eugrastidium* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 188 (1910) (nom. illeg.; ICBN Art. 21.3).** Type species: *Grastidium rugosum* Blume = *Dendrobium rugosum* (Blume) Lindl. (here chosen) [= *Dendrobium* sect. *Grastidium* Blume]

Note – Kraenzlin did not include *D. salaccense* (Blume) Lindl., the type species of sect. *Grastidium*, in his section *Eugrastidium*.

***Dendrobium* sect. *Eudendrobium* subsect. *Fasciculata* Benth. & Hook.f., Gen. Pl. 3: 501 (1883).** Type species: *Epidendrum moniliforme* L. = *Dendrobium moniliforme* (L.) Sw. (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Nobilia* subsect. *Fimbrilabia* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 27 (1910).** Type species: *Dendrobium devonianum* Paxton. (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Eudendrobium* subsect. *Foliosae* Benth. & Hook.f., *Gen. Pl.* 3: 501 (1883).** Type species: *Grastidium salaccense* Blume = *Dendrobium salaccense* (Blume) Lindl. (here chosen) [= *Dendrobium* sect. *Grastidium* Blume]

***Dendrobium* sect. *Eudendrobium* subsect. *Grandia* Rchb.f. in Walp., *Ann. Bot. Syst.* 3: 532 (1853) (nom. invalid.).**

Note – As this is a nomen nudum, no typification is required. The two species listed by Reichenbach both belong to *Dendrobium* sect. *Dendrobium*.

***Dendrobium* sect. *Hemiphylla* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 201 (1910).** Type species: *Macrostomium aloifolium* Blume = *Dendrobium aloifolium* (Blume) Lindl. (here chosen) [= *Dendrobium* sect. *Aporum* Blume]

***Dendrobium* sect. *Holophylla* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 201 (1910).** Type species: *Aporum lobatum* Blume = *Dendrobium lobatum* (Blume) Miq. (here chosen) [= *Dendrobium* sect. *Aporum* Blume]

***Dendrobium* sect. *Nobilia* subsect. *Integrilabia* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 27 (1910).** Type species: *Dendrobium nobile* Lindl. (here chosen) [= *Dendrobium* sect. *Dendrobium*]

Note – Kraenzlin did not use *Nobilia* as the name of this subsection, nor was he required to do so (ICBN Art. 22.1).

***Dendrobium* sect. *Leiotheca* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 250 (1910).** Type species: *Latouria spectabilis* Blume = *Dendrobium spectabile* (Blume) Miq. (here chosen) [= *Dendrobium* sect. *Latouria* (Blume) Miq.]

***Dendrobium* sect. *Glomerata* subsect. *Macrocentra* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 103 (1910).** Type species: *Dendrobium ionopus* Rchb.f. (here chosen) [= *Dendrobium* sect. *Pedilonum* Blume]

Notes – See the notes under subsect. *Camptocentra*.

***Dendrobium* sect. *Glomerata* subsect. *Mesocentra* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 102 (1910).** Type species: *Dendrobium glomeratum* Rolfe. (here chosen) [= *Dendrobium* sect. *Calyptrochilus* Schltr.]

Note – See the note under sect. *Capitata*.

***Onychium* (Blume) Blume, *Bijdr.* 323 (1825).** Type species: *Onychium japonicum* Blume (= *Dendrobium moniliforme* (L.) Sw.) (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Onychium* Blume, *Tab. Pl. Jav. Orchid.* (1825) in Clavis Generum.** Type species: *Onychium japonicum* Blume (= *Dendrobium moniliforme* (L.) Sw.) (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Aurea* subsect. *Percnochila* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 40 (1910).** Type species: *Dendrobium aureum* Lindl. (= *D. heterocarpum* Wall. ex Lindl.) (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Planifolia* Rchb.f. in Walp., *Ann. Bot. Syst.* 6: 282 (1861).** Type species: *Dendrobium nobile* Lindl. (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Ceratobium* subsect. *Platypetala* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 139 (1910).** Type species: *Onychium affine* Decne. = *Dendrobium*

affine (Decne.) Steud. (here chosen) [= *Dendrobium* sect. *Phalaenanthe* Schltr.]

***Dendrobium* sect. *Eudendrobium* subsect. *Pycnostachyae* Benth. & Hook.f., *Gen. Pl.* 3: 500 (1883).** Type species: *Dendrobium purpureum* Roxb. (here chosen) [= *Dendrobium* sect. *Calyptrochilus* Schltr.]

Note – See the note under sect. *Capitata*.

***Dendrobium* sect. *Rhopalanthe* Schltr., *Repert. Spec. Nov. Regni Veg. Beih.* 1: 449 (1912).** Type species: *Dendrobium crumenatum* Sw. (here chosen) [= *Dendrobium* sect. *Aporum* Blume]

Note – Section *Crumenata*, of which sect. *Rhopalanthe* is a homotypic synonym, is in Pridgeon *et al.* (in prep.) included in a broadly defined sect. *Aporum*.

***Dendrobium* sect. *Strongyle* Lindl., *Paxton's Fl. Gard.* 1: 134 (1850-51).** Type species: *Onychium subulatum* Blume = *Dendrobium subulatum* (Blume) Lindl. (lectotype chosen by Brieger (1981), who mistakenly wrote '*Onychium undulatum*', a name which does not exist; *Onychium subulatum* is the only species of *Onychium* which belongs to sect. *Strongyle*) [= *Dendrobium* sect. *Aporum* Blume]

***Dendrobium* sect. *Aurea* subsect. *Subcylindracea* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 41 (1910).** Type species: *Dendrobium chrysanthum* Lindl. (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Superbientia* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 257 (1910).** Type species: *Dendrobium johnsoniae* F.Muell. (here chosen) [= *Dendrobium* sect. *Latouria* (Blume) Miq.]

Note – *Dendrobium* × *superbiens* Rchb.f. cannot be considered the type species in the sense of ICBN Art. 22.6, as it is a hybrid, not a species, even though Kraenzlin considered it as such. He listed several other species in this ill-defined section, including members of section *Phalaenanthe* but also of sections *Latouria*, *Formosae* and even *Pedilonum*. Choosing one of the *Phalaenanthe* species would have given sect. *Superbientia* priority over sect. *Phalaenanthe*.

***Dendrobium* sect. *Trachytheca* Kraenzl. in Engl., *Pflanzenr.* IV. 50. II. B. 21: 243 (1910).** Type species: *Dendrobium macrophyllum* A.Rich. (here chosen) [= *Dendrobium* sect. *Latouria* (Blume) Miq.]

***Dendrobium* sect. *Eudendrobium* subsect. *Trilobata* Pfitzer in Engl. & Prantl, *Nat. Pflanzenfam.* 2, 6: 174 (1889).** Type species: *Dendrobium maccarthiae* Thwaites (here chosen) [= *Dendrobium* sect. *Dendrobium*]

***Dendrobium* sect. *Virgatae* Hook.f., *Fl. Brit. Ind.* 5: 711 (1890).** Type species: *Dendrobium crumenatum* Sw. (here chosen) [= *Dendrobium* sect. *Aporum* Blume]

Note – See note under sect. *Rhopalanthe*.

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References

Adams, P.B. (2011). Systematics of Dendrobiinae (Orchidaceae), with special reference to Australian taxa. *Bot. J. Linn. Soc.* **166**, 105–126.

Brieger, F.G. (1981). Subtribus Dendrobiinae. In R. Schlechter (F.G. Brieger, R. Maatsch, and K. Senghas, eds), *Die Orchideen*, 3rd edn, **Vol. 1** (11–12), 636–752. Parey: Berlin.

Govaerts, R. (2011). *World Checklist of Selected Plant Families.* The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; http://www.kew.org/wcsp/ (accessed 20 June 2011).

Holttum, R.E. (1953). *Orchids of Malaya.* Government Printing Office: Singapore.

Hooker, J.D. (1890) *The Flora of British India*, **Vol. 5.** L. Reeve & Co.: London.

McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Hawksworth, D. L., Marhold, K., Nicolson, D. H., Prado, J., Silva, P. C., Skog, J. E., Wiersema, J. H., and Turland, N. J. (eds) (2006). *International Code of Botanical Nomenclature* (Vienna Code), adopted by the Seventeenth International Botanical Congress Vienna, Austria, July 2005. A. R. G. Gantner Verlag, Ruggell: Liechtenstein. [Regnum Veg. 146].

Pridgeon, A.M., Cribb, P.J., Chase, M.W., and Rasmussen, F.N. (in prep.). *Genera Orchidacearum*, **Vol. 6.** Oxford University Press: Oxford.

Schuiteman, A. (2011). *Dendrobium* (Orchidaceae): to split or not to split. *Gard. Bull. Singapore* **63**(1&2), 247–259.

Schuiteman, A. and Adams, P.B. (2010). A broad look at *Dendrobium*. *Orchadian* **16**, 447–459.

Two new rare species in the *Thelymitra venosa* complex (Orchidaceae) from south-eastern mainland Australia

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Abstract

Two rare species, *Thelymitra alpicola* Jeanes and *Thelymitra incurva* Jeanes, are described as new and illustrated. Their relationship with *Thelymitra cyanea* (Lindl.) Benth., *Thelymitra erosa* D.L.Jones and M.A.Clem. and *Thelymitra venosa* R.Br. is discussed and information on distribution, habitat, pollination biology, flowering time and conservation status is given for all five species. A key is also provided to distinguish the five species. The confusion arising from the incorrect application of names in the complex is discussed, including reference to the related New Zealand species *Thelymitra pulchella* Hook.f.

Keywords: sun orchids, taxonomy, diagnostic features

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Introduction

Thelymitra J.R. Forst. & G. Forst. is a complex genus of orchids consisting of more than 100 described species, several described natural hybrids and at least eight undescribed taxa. It is concentrated in higher rainfall areas of temperate Australia, but a few species occur in tropical north-eastern Australia, about 20 species occur in New Zealand (15 endemic) and a few species occur in Indonesia, New Caledonia, New Guinea and the Philippines.

Members of the small *Thelymitra venosa* R.Br. complex share several morphological features that, in combination, distinguish them from all other members of the genus. The post-anther lobe of the column is rather short and only partially hoods the anther. The dorsal surface is irregularly rugulose and the distal margin is irregularly sinuate, sometimes with a central tooth. The lateral lobes of the column lack hair tufts, are smooth and flattened, sometimes twisted or coiled, with irregularly toothed, lobed or erose margins.

Taxonomic history and discussion

Historically there has been some confusion about the correct application of names and the interpretation of species within the *T. venosa* complex. At least some of this confusion has persisted until very recently and has revealed itself in the many floras and orchid books published during that time.

Brown (1810) described *T. venosa* from material he collected at Port Jackson in 1803. This species has several large, prominently veined flowers with a broadly obovate labellum and long, tightly coiled lateral lobes on the column. Lindley (1839–40) described *Macdonaldia cyanea* Lindl. from material collected by Gunn (collection number 938) at Circular Head Tasmania in 1837. This species is similar to *T. venosa* but has generally fewer, smaller flowers that have shorter, less obviously coiled lateral lobes. Bentham (1873) made the combination *Thelymitra cyanea* (Lindl.) Benth. and clearly distinguished this species from *T. venosa*. Rodway (1903) incorrectly attributed the name *T. venosa* to plants common in Tasmania

(probably *T. cyanea*) while attributing the name *T. cyanea* to another common Tasmanian species (undescribed at the time and later to become *Thelymitra erosa* D.L.Jones and M.A.Clem.) with erose lateral lobes on the column. This confusion of names was perpetuated by Rogers (1911) and Black (1922) when they attributed the name *T. venosa* to plants from South Australia and Ewart (1931) when he attributed the name *T. venosa* to plants from Victoria. Nicholls (1935) invalidly published the combination *T. venosa* var. *speciosa* Nicholls, a superfluous name for the large flowering taxon from the Sydney sandstone area, clearly Brown's *T. venosa*. Rupp (1939) published the combination *T. venosa* var. *magnifica* another superfluous name for the same taxon, and later (Rupp 1943) perpetuated his concepts. The taxonomic and nomenclatural confusion became further entrenched with the publication of the excellent colour paintings of William Nicholls and the accompanying text (see Nicholls 1951 and Nicholls 1969). Hatch (1952) created the combinations *T. venosa* var. *cedricsmithii* Hatch(= ?*T. cyanea*), *T. venosa* var. *cyanea* (Lindl.) Hatch (= *T. cyanea*) and *T. venosa* var. *typica nom. illeg.* (the autonym, correctly *T. venosa* var. *venosa*), the latter incorrectly applied by Hatch to the widespread taxon *T. cyanea* but possibly also encompassing *T. venosa*. Most Australian botanists did not follow Hatch's classification. The name *T. cyanea* was by this time linked firmly with taxa with erose lateral lobes in Tasmania (Rodway 1903), Victoria (Nicholls 1951) and later in New South Wales (Nash 1968). Following his study of the type specimens, Clements (1989) confirmed that *T. venosa* was more or less confined to the Sydney sandstone region. He also concluded that *T. cyanea* was the very common species from alpine, subalpine and lowland swamps of south-eastern Australia (including Tasmania) and New Zealand, and the plants from the Australian alps with erose lateral lobes were conspecific with the New Zealand *Thelymitra pulchella* Hook.f. However, Clements' treatment did not account for plants with erose lateral lobes from lowland areas of Victoria or from Tasmania. Jones (1988) used Clements' classification, but only attributed *T. pulchella* to New South Wales and New Zealand. Bernhardt (1993) followed Clements (1989), while Backhouse and Jeanes (1995) followed Clements (1989), but attributed *T. pulchella* to New South Wales, Victoria and Tasmania and also included an apparently undescribed taxon from lowland areas of East Gippsland Victoria as *T.* sp. aff. *pulchella* (described herein as *Thelymitra incurva* Jeanes). Further study of the type specimens of *T. pulchella* (Jones and Clements 1998) revealed that this species is not present in Australia after all, but is endemic to New Zealand. This research also revealed that possibly three or more distinct taxa shelter under the name *T. pulchella* in New Zealand. Jones and Clements (1998) described the species from Tasmania with erose lateral lobes as *T. erosa* while alluding to the plants from highland areas of south-eastern Australia as possibly being conspecific. My research has shown these latter plants to be distinct and are herein described as *Thelymitra alpicola* Jeanes.

Explanation of the terminology used

The genus *Thelymitra* is unusual in the Orchidaceae in that the six perianth segments generally differ very little from each other in terms of size, shape and ornamentation. The labellum does not bear any hairs, calli, glands, ridges, lobes, teeth or fringes and is apparently not involved in pollination. Since the perianth is virtually actinomorphic and generally lacks characters by which to distinguish the species, traditionally the structure of the column has supplied most of these distinguishing characters. Over the years a terminology has evolved to describe the column structure in *Thelymitra*, but some of these terms are poorly understood and some have never been defined adequately. Below is an explanation of some of the terms commonly used in this paper; most have a traditional usage, although this has often not been well understood.

***Column* (gynostemium)**: The column is exposed in the centre of the flower, it lacks a free filament and style, is short and thick and broadly winged from below the stigma to the level of the anther or beyond. The apex is usually 3–5-lobed and is often ornamented with hairs, fringes, teeth, calli, glands, tubercles or lobes. In the *T. venosa* complex the apex of the column extends to just beyond the point of insertion of the anther and the lateral lobes into a short post-anther lobe.

***Post-anther lobe* (mid-lobe)**: This structure protrudes beyond the point of insertion of the anther and of the lateral lobes, and it is usually of a different colour to the rest of the column. It has a complex vascular supply always associated with that of the functional anther and may be regarded as an outgrowth of the filament. In

some species it is represented only by a short flap or a band of small calli crowded across the back of the anther. In most species it extends well beyond the anther with a free margin that may be plain, undulate, toothed, notched or variously ornamented with tubercles. At its maximum development it forms a fleshy, tubular hood that is variously open on the ventral side and overhangs and obscures the anther. In the *T. venosa* complex the post-anther lobe is poorly developed and only partially hoods the anther. The dorsal surface is irregularly rugulose and the distal margin often sinuate and thickened, sometimes with a central tooth.

Lateral lobes **(column-arms or lateral staminodes):** These two structures are inserted one on each side of the post-anther lobe and extend forward or upward and often converge. They are each supplied by a single unbranched vascular bundle and are thought to represent staminodes. They may be flat and ribbon-like, terete and finger-like, straight, curved, twisted spirally or bent sharply, and are usually ornamented with lobes, teeth, tubercles or hairs. In the *T. venosa* complex the lateral lobes are smooth and flattened, sometimes twisted or coiled, with irregularly toothed, lobed or erose margins.

Table 1. Taxanamic history af the *T. venasa* camplex shawing the names used by variaus authars far the five Australian taxa recagnised in the current treatment.

Author	Name used				
Brawn (1810)	*T. venasa*	nane	nane	nane	nane
Lindley (1839–40)	*T. venasa*	*Macdanaldia cyanea*	nane	nane	nane
Lindley (1840)	*T. venasa*	*Macdanaldia cyanea*	nane	nane	nane
Haaker (1858)	*T. venasa*	*T. venasa*	nane	nane	nane
Reichenbach (1871)	*T. venasa*	nane	nane	nane	nane
Bentham (1873)	*T. venasa*	*T. cyanea*	nane	nane	nane
Mueller (1882)	*T. venasa*	*T. cyanea*	nane	nane	nane
Radway (1903)	nane	*T. venasa*	*T. cyanea*	nane	nane
Rupp (1943)	*T. venasa* var. *magnifica*	*T. venasa*	nane	nane	nane
Nichalls (1951)	*T. venasa* var. *magnifica*	*T. venasa*	*T. cyanea*	*T. cyanea*	*T. cyanea*
Willis (1962)	nane	*T. venasa*	*T. cyanea*	*T. cyanea*	*T. cyanea*
Nichalls (1969)	*T. venasa* var. *magnifica*	*T. venasa*	*T. cyanea*	*T. cyanea*	*T. cyanea*
Gray (1966 and1971)	nane	*T. venasa*	*T. cyanea*	*T. cyanea*	*T. cyanea*
Curtis (1979)	nane	*T. venasa*	*T. cyanea*	*T. cyanea*	?*T. cyanea*
Janes (1988)	*T. venasa*	*T. cyanea*	nane	*T. pulchella*	nane
Clements (1989)	*T. venasa*	*T. cyanea*	nane	*T. pulchella*	nane
Bernhardt (1993)	*T. venasa*	*T. cyanea*	nane	*T. pulchella*	nane
Weber and Entwisle (1994)	*T. venasa*	*T. cyanea*	nane	*T. pulchella*	*T. pulchella*
Backhause and Jeanes (1995)	*T. venasa*	*T. cyanea*	*T. pulchella* p.p. *T.* sp. aff. *pulchella* p.p.	*T. pulchella*	*T.* sp. aff. *pulchella*
Janes and Clements (1998)	*T. venasa*	*T. cyanea*	*T. erasa*	?*T. erasa*	*T. erasa*
Bishap (2000)	*T. venasa*	*T. cyanea*	nane	*T. pulchella*	nane
Jeanes and Backhause (2000)	nane	*T. cyanea*	nane	*T.* sp. aff. *erasa*	*T. erasa*
Jeanes and Backhause (2006)	nane	*T. cyanea*	nane	*T. erasa* subsp. 2	*T. erasa* subsp. 1
Janes (2006)	*T. venasa*	*T. cyanea*	*T. erasa*	*T. alpicala* (ined.)	*T. incurva* (ined.)
Jeanes (2012, this paper)	*T. venasa*	*T. cyanea*	*T. erasa*	*T. alpicala*	*T. incurva*

***Auxiliary lobes* (accessory lobes or side lobules)**: Several species of *Thelymitra* have a pair of distinct lobes between the post-anther lobe and the lateral lobes. These have no vascular strand and are most accurately described as being part of a tripartite post-anther lobe. They tend to be fleshy with irregularly jagged margins and sometimes have small surface tubercles. In the *T. venosa* complex they are completely absent.

Anther: In *Thelymitra*, the anther is usually small, ovoid, and situated entirely between the column wings. The connective extends beyond the pollinia into an apical beak-like projection of varying size. The anther may be entirely above the stigma or variously obscured behind it. In the *T. venosa* complex the anther is inserted towards the apex of the column at anthesis. The dorsal surface is papillose and the anther beak is moderately large and may be entire or bifid at the apex.

Pollinia: Members of the genus *Thelymitra* contain four pollinia in two groups of two. In the *T. venosa* complex the pollen grains may be tightly bound with the pollinarium being removed by insects as a single unit (in *T. venosa*), or, more usually, the pollen is friable leading to autogamy.

Stigma: The stigma in *Thelymitra* is more or less bilobed at the apex, usually quadrate or transverse-elliptic in shape and located at the base of the column on a thick stalk.

Materials and methods

This paper is the result of a qualitative and quantitative study of the pertinent type material (or photographic reproductions thereof), all the available herbarium specimens (both dry and spirit-preserved) from AD, BM, BRI, CANB, E, HO, MEL, NSW, P, PERTH, QRS, SUNIV and WELT, and freshly collected specimens of all taxa except *T. venosa*, which were vouchered and deposited at the relevant herbaria. Orchid taxa in general, and *Thelymitra* taxa in particular, are much more readily identified from fresh living material where characters of the perianth, the column, flower colour and fragrance are still intact. Familiarity with the taxa gained from field study and the study of freshly collected specimens sent to me by field operatives has made the identification of dried and spirit-preserved herbarium material (including type specimens) much easier.

When collecting *Thelymitra* for study it is essential that the entire above ground parts of the plant be taken, with the majority of the material being preserved in spirit. Plants preserved in the pressed state are often difficult to identify to species level in the absence of additional information. Spirit-preserved specimens on the other hand, are generally much more easily identified to species level. The observation of plants growing *in-situ* is the ideal method of study for *Thelymitra* in general, and often it is only by this method that cryptic new species can be identified. For this reason the importance of field work in the study of species complexes within *Thelymitra* cannot be overstated and should form an integral part of any future studies of the group or its individual members.

Taxonomy

1. *Thelymitra venosa* R.Br., *Prodr.* 314 (1810).

Type: Port Jackson; marshes towards Botany Bay, x.–xi.1803, *R. Brown s.n.* (lectotype 'a' BM!, fide Clements 1989; isolectotype BM!).

Macdonoldio venosa (R.Br.) Lindl., Edwards's Bot. Reg. appendix to vols 1–23 [Sketch Veg. Swan R.]: 50 (1839–40).

Thelymitra venosa R.Br. var. *speciosa* Nicholls, Orchidol. Zeylanica 2: 157 (1935), nom. inval.

Thelymitra venosa R.Br. var. *magnifica* Rupp, *Austrol. Orchid Rev.* 4: 81 (1939). Type: Wentworth Falls, xi.1916, *H.M.R. Rupp s.n.* (lectotype NSW! fide J.Z. Weber 1988 *in sched.*; isolectotype AD!); Syntypes: Laura, xi.1926, *E.Stephen s.n.* (AD!)

Illustrations: Bauer (1803) colour drawing; Nicholls (1969) plate 50, fig. a (as *T. venosa* var. *magnifica*); Bishop (2000) plate 49; Jones (2006) page 250.

Glabrous terrestrial *herb. Tubers* ovoid, 1.5–4 cm long, 5–15 mm wide, fleshy. *Leaf* linear, 10–30 cm long, 5–10 mm wide, erect, canaliculate, pale to dark green, ribbed abaxially, fleshy, sheathing at base, apex acute. *Scape* 25–70 cm tall, 1.5–3 mm diam., slender, wiry, pale green to purplish. *Sterile bracts* 1 or 2, rarely 3, linear-lanceolate, 1.8–4 cm long, 3–9 mm wide, closely sheathing, acute to shortly acuminate, green to purplish. *Fertile bracts* ovate-acuminate to obovate-acuminate, 5–20 mm long, 3–7 mm wide, sheathing the pedicels, green or purplish. *Pedicels* 8–16 mm long, slender. *Ovary* cylindric to narrow-obovoid, 5–13 mm

Key to the Australian species in the *T. venosa* complex.

1 Labellum broadly obovate, different in shape from the other perianth segments; lateral lobes of column entire or lobed at apex, variously twisted; anther beak bifid at apex 2

1: Labellum obovate to oblanceolate, not greatly different in shape from the other perianth segments; lateral lobes of column with margins variously erose; anther beak sometimes slightly emarginate, but not bifid at apex 3

2 Flowers 35–50 mm across; lateral lobes of column twisted in a long, tight coil; New South Wales central coast and Blue Mountains ..... **1. *T. venasa***

2: Flowers 25–30 mm across; lateral lobes of column twisted in a short open spiral; widespread in south-eastern Australia ..... **2. *T. cyanea***

3 Lateral lobes of column somewhat concave on the inner surface, often strongly incurved throughout, apices usually touching or overlapping; perianth pale blue (rarely pink) inside, lacking obvious darker striations; moist sandy sites often around the edges of grasstree plains ..... **5. *T. incurva***

3: Lateral lobes of column more or less flat, more or less parallel to weakly incurved, apices rarely touching; perianth mid-blue to purplish blue or pink inside with obvious darker striations; habitat not as above 4

4 Perianth mid-blue to pale purplish or pink with variable darker longitudinal striations; lateral lobes of column often very broad at the base and deeply erose; Tasmania only, where widespread ..... **3. *T. erasa***

4: Perianth deep purplish blue with very strong darker longitudinal striations; lateral lobes of column often narrow at base and shallowly erose; mostly alpine and montane mainland south-eastern Australia ..... **4. *T. alpicala***

long, 1–4 mm wide. *Flowers* 1–8, 25–50 mm across, dark blue with darker blue longitudinal veins, particularly on the dorsal sepal and petals, rarely white or pink, opening freely even in cool weather and often remaining open at night. *Perianth segments* 12–25 mm long, 5–14 mm wide, thin textured, flat or slightly concave, sometimes recurved, often shortly apiculate; *dorsal sepal* ovate-lanceolate to ovate, obtuse or acute; *lateral sepals* ovate-lanceolate to ovate, often slightly asymmetric, more or less acute; *petals* ovate to obovate, obtuse or acute; *labellum* broadly obovate, broader than other perianth segments, distal margins often crisped, obtuse. *Column* erect from the end of ovary, 3–4.5 mm long, 2.5–3.5 mm wide, broadly winged, white to pale blue; *post-anther lobe* not hooding the anther, very short, covered with beady glands, cream; *auxiliary lobes* absent; *lateral lobes* more or less parallel, 2–3 mm long, 0.8–1.2 mm wide, flattened, obliquely erect, spirally twisted, yellow, apex entire. *Anther* inserted near apex of column, ovoid, 3–3.6 mm long, 1.8–2.7 mm wide, protruding forward at c. 90 deg. to column, white, dorsal surface minutely papillose, connective produced into a yellow bifid beak 1–1.5 mm long (branches 0.4–0.6 mm long); *pollinarium* 2–2.5 mm long; *viscidium* more or less circular, c. 0.5 mm diam.; *pollinia* coherent, white. *Stigma* situated near base of column, transversely elliptic, 1.5–2 mm long, 1.8–2.5 mm wide, concave, margins irregular. *Capsules* obovoid, 15–20 mm long, 5–9 mm wide, erect, ribbed. (Fig. 1a; 4a)

***Selected specimens examined*: NEW SOUTH WALES**: Leura, xi.1926, *H.M.R. Rupp s.n.* (MEL 625607, MEL 625361); Port Jackson District, xi.1896, (MEL 114441); Wentworth Falls, Blue Mountains, x.1948, *I. Bowden s.n.* (MEL 1532680); Blue Mountains, xii.1883, *R. Thorn s.n.* (MEL 1550454); Govett's Leap, Blue Mountains, 22.xi.1897, *G. Lyell s.n.* (MEL 573451); Central Tablelands: Mt Victoria, xii.1963, *W. Brinsley s.n.* (CANB 8104537); Central Coast: East Kangaloon, 9.xi.1969, *B. Whitehead s.n.* (CANB 8104533); Undercliff Walk, Wentworth Falls, 2.xii.1990, *A.D. Bishop J130/6-8 and J.F. Keller* (NSW 274068); Mt Victoria, 7.xii.1890, *R.J.B. s.n.* (NSW 465641); Central Tablelands: c. 7 km SW of Katoomba, Narrowneck Peninsula, 24.i.1989, *D.L. Jones 3481 and G. Savage* (CANB 8901337); Medlow, Blue Mountains, xii.1906, *G.A. Wilson s.n.* (NSW 190381); Katoomba, 17.xii.1927, *G.V. Scammell s.n.* (NSW 190379); Upper Carrington Falls, 11.xii.1960, *E. and L.I. Cady s.n.* (NSW 182838); Leura, xi.1926, *E. Stephen s.n.* (MEL 114432, MEL 2045062, MEL 573527, NSW 190380, NSW 190382, AK 96346).

Distribution and habitat: Endemic to New South Wales, where confined to the Blue Mountains and nearby coastal areas. Grows on sandstone rock ledges among low shrubs, sedges and mosses in wet soils. Altitude: 10–1000 m. (Fig. 2a)

Conservation status: Rare and of very limited distribution. Suggest 2RC by criteria of Briggs and Leigh

Figure 1. Photographs of species: a. *Thelymitra venosa* (photo R. Tunstall); b. *Thelymitra cyanea* (photo J. Jeanes, RBG Melbourne); c. *Thelymitra erosa* (photo M. Clements, CSIRO Canberra); d. *Thelymitra alpicola* sp. nov. (photo J. Jeanes, RBG Melbourne); e. *Thelymitra incurva* sp. nov. (photo J. Jeanes, RBG Melbourne).

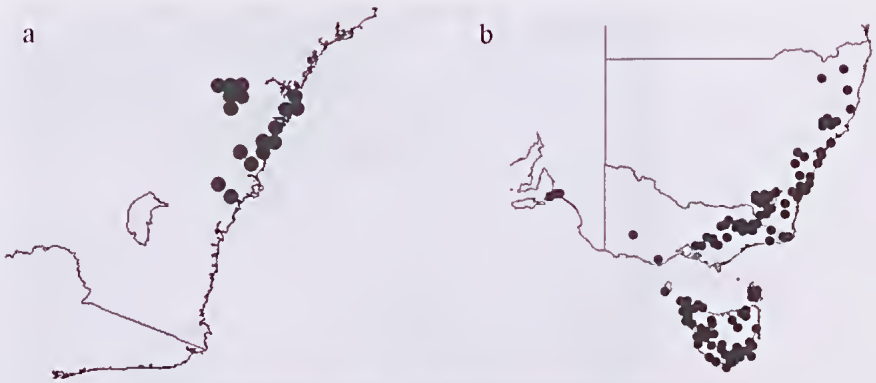

Figure 2. Distribution maps of: a. *Thelymitra venasa*; b. *Thelymitra cyanea*

(1996) and Near Threatened (NT) by criteria of IUCN (2011).

Flowering period: October to January.

Pollination biology: The large, easily opening flowers, functional viscidium and sporadic capsule production would suggest that this species is most likely entomophilous.

Typification: The type sheet contains five specimens from two different collections. The two specimens on the right appear to have been collected at Port Jackson in 1803 by Robert Brown and one of these (a) was selected by Clements (1989) as the lectotype. The three specimens on the left appear to be of the same taxon but were collected much later by Robert Fitzgerald.

Notes: *Thelymitra venosa* is closely related to *T. cyanea* (mostly from high altitude parts of south-eastern Australia and New Zealand), but the latter has generally fewer, smaller flowers and the lateral lobes have fewer, looser twists and lobed apices.

The ease with which the flowers of *T. venosa* open, and their propensity to stay open at night, are unusual for the genus.

2. *Thelymitra cyanea* (Lindl.) Benth., Fl. Austral. 6: 323 (1873).

Macdonaldia cyanea Lindl., *Edwards's Bot. Reg.* appendix to vols 1–23 [Sketch Veg. Swan R.]: 50 (1839–40). *Thelymitra venosa* R.Br. var. *cyanea* (Lindl.) Hatch, *Trans. & Proc. Roy. Soc. New Zealand* 79: 391 (1952). *Type*: Tasmania, Circular Head, xii.1837, *R. Gunn 938* (lectotype specimen 12a K!, *fide* Clements 1989; isolectotypes BM!, FI!, K, P!, NSW!). *Syntypes*: Tasmania, Rocky Cape, xii.1837, *R. Gunn 944* (K!).

Thelymitra uniflora Hook.f., *Fl. Antarct.* 1: 70 (1844). *Type*: Lord Aukland's Group; on the bare ground and growing in tufts of moss, Forstera, &c., on bleak hills, *J.D. Hooker s.n.* (holotype K).

Thelymitra venosa R.Br. var. *cedricsmithii* Hatch, *Trans. & Proc. Roy. Soc. New Zealand* 79: 390 (1952), *nom. nud.*

Thelymitra venosa R.Br. var. *typica* Hatch, *Trans. & Proc. Roy. Soc. New Zealand* 79: 390 (1952), *nom. illeg.*

Epiblema grandiflorum Buchanan, *Trans. & Proc. New Zealand Inst.* 14: 356 (1882), *non* R.Br. (1810).

Thelymitra venosa auct., non R.Br. (1810); T.F. Cheeseman, *Man. New Zealand Fl.* 343 (1925); J.H. Willis, *Handb. Pl. Victoria*, 1: 352 (1962); W.M. Curtis, *Stud. Fl. Tasmania* 4A: 48 (1979).

Illustrations: Nicholls (1969) plate 50, figs b–i. (as *Thelymitra venosa*); Jones (1988) page 294; Backhouse and Jeanes (1995) page 336; St George *et al.* (1996) page 104; St George (1999) page 139; Bishop (2000) plate 48; Jones (2006) page 250.

Glabrous terrestrial *herb*. *Tubers* ovoid, 1–3 cm long, 5–12 mm wide, fleshy. *Leaf* linear, 10–25(–37) cm long, 3–8 mm wide, erect, canaliculate, pale to dark green, ribbed abaxially, fleshy, sheathing at base, apex acute. *Scape* 15–55 cm tall, 1–2.5 mm diam., slender, wiry, pale green to purplish. *Sterile bracts* usually 2, rarely 1 or 3, linear-lanceolate, 18–55 mm long, 3–9 mm wide, closely sheathing, lower one often partially enclosed by leaf, acute to acuminate, green to purplish. *Fertile bracts* ovate-acuminate to obovate-acuminate, 5–20 mm long, 3–7 mm wide, sheathing the pedicels, green or purplish. *Pedicels* 2–15 mm long, slender. *Ovary* cylindric

to narrow-obovoid, 4–12 mm long, 2–4 mm wide. *Flowers* 1–4, 20–32 mm across, bright blue with darker blue longitudinal veins, particularly on dorsal sepal and petals, rarely white with blue veins or pink with brown veins, opening freely in warm weather. *Perianth segments* 8–16 mm long, 3.5–10 mm wide, thin textured, flat to slightly concave, often shortly apiculate; *dorsal sepal* ovate-lanceolate, obtuse or acute; *lateral sepals* lanceolate to oblanceolate, slightly asymmetric, more or less acute; *petals* ovate to obovate, obtuse or acute; *labellum* broadly obovate, broader than other perianth segments, distal margins often crisped, obtuse. *Column* erect from the end of ovary, 4–5.5 mm long, 2.5–3.5 mm wide, broadly winged, white to pale blue; *post-anther lobe* not hooding the anther, very short, covered with beady glands, cream; *auxiliary lobes* absent; *lateral lobes* more or less parallel, 1.5–2.5 mm long, 0.6–1 mm wide, fleshy, obliquely erect, often spirally twisted, yellow, base of inner margins with beady glands, apex often variously lobed. *Anther* inserted near apex of column, ovoid, 3–3.5 mm long, 1.8–2.7 mm wide, protruding forward at c. 90 deg. to column, white, dorsal surface minutely papillose, connective produced into a bifid beak c. 1 mm long (branches 0.3–0.6 mm long); *pollinarium* 2.2–2.5 mm long; *viscidium* more or less circular, c. 0.3 mm diam.; *pollinia* white, friable, mealy. *Stigma* situated near base of column, transversely elliptic, 1.5–2 mm long, 1.8–2.5 mm wide, concave, margins irregular. *Capsules* obovoid, 10–15 mm long, 4–7 mm wide, erect, ribbed. (Fig. 1b; 4b).

***Selected specimens examined*: SOUTH AUSTRALIA:** Lofty South District: near Mt Compass; Yundi Swamps, 26.xii.1979, *M.A. Clements 1756* (CANB 8000468); Lofty South District: Square Water Hole Swamp, near Mt Compass, 9.xii.1967, *R. Nosh s.n.* (CANB 8104535); Southern Lofty District: Mt Compass, 15.xii.1907, *R.S. Rogers S157* (AD RSR5157); Mt Compass, 15.xii.1907, *R.S. Rogers s.n. and Mrs Rogers* (AD 97720251, AD 97518167, AD 97720249, AD 97720248, NSW 182871); Mt Compass, 15.xii.1907, *Mrs R.S. Rogers s.n.* (AD 96945202); Myponga, xii.1906, *Mrs R.S. Rogers s.n.* (NSW 182870); Myponga, 9.xii.1906, *Mrs R.S. Rogers s.n.* (AD 97720250A); Square Waterhole, 20.xii.1906, *Mrs R.S. Rogers s.n.* (AD 97720250B); Myponga, 19.xii.1906, *R.S. Rogers 5156 and Mrs Rogers* (AD 977202S2); Myponga, Wittles Swamp, 23.xii.1906 (AD 97518168); Southern Lofty District: Peat bog behind 'Upson Downs' homestead, 23.i.1988, *R.J. Bates 13860* (AD 98809064). **NEW SOUTH WALES:** Braidwood District, xii.1884, *W. Bonerton 278* (MEL 114433); Barrington Tops, i.1926, *H.M.R. Rupp s.n.* (MEL 625279); Saxby's Swamp, Barrington, 7.i.1959, *R. Filson 1418* (MEL 622704); Barrington Tops, xii.1925, *H.M.R. Rupp s.n.* (MEL 625605); North coast; Near Wauchope; 16 km W of Rollands Plains, top of the range, 9.xii.1979, *M.A. Clements 1740* (CANB 7911529); Carrington Falls area, Jamberoo Hut, 11.xii.1960, *E. and L.I. Cody s.n.* (CANB 64984); Mt Kosciusko, 22.i.1952, *E. Goubo s.n.* (CANB 14373); Happy Jacks Plains, Snowy Mountains (Boobee Hut), 17.i.1966, *E.J. Carroll s.n.* (CANB 17107); South coast: Northern Budawang Range, Camping Rock Creek, 5 of Sassafras, 20.xii.1972, *J. Pulley s.n. and I. Telford* (CANB 8307305); Braeside Walk (Blackheath end). Blue Mountains National Park, 21.xii.1990, *A.D. Bishop J130/26-33 and J.F. Keller* (NSW 274067). **AUSTRALIAN CAPITAL TERRITORY:** Mt Bimberi, SW of Canberra, 14.i.1970, *J.H. Willis s.n.* (MEL 114555); Brindabella Range, 1.5 km NE of Mt Ginini, Ginini Flats, 28.i.1977, *M.D. Crisp 2464 and R. Nipperess* (CANB 67174); Mt Murray, Bimberi Range, 52 km SW of Canberra, 2.ii.1977, *H. Streimann s.n.* (CANB 67186); Brindabella Mountains, Snowy Flats, 5.1 km past locked gate at Mt Ginini, 3.iii.1993, *C.H. Broers 354 and D.L. Jones* (CANB 9306306); Snowy Flats, Bimbera Range, Cotter River District, 14.i.1968, *L.G. Adams 2039* (CANB 172104); Mt Little Ginini, 10.i.1952, *N.T. Burbidge 36B2* (CANB 2S880); Mt Gingera, 16.i.1954, *M. Tindale s.n.* (NSW 182855); Bimberi Peak, 15.i.1912, *R.H. Comboge s.n.* (NSW 182854). **VICTORIA:** Rocky Plains, 7 km S of Mt Cobberas No. 1, 26.i.1970, *T.B. Muir 4821* (MEL 518808); Bogong High Plains. Near Middle Creek, upstream from Scout Hut, 19.i.1959, *T.B. Muir 683* (MEL 114S41); Carlisle State Park, 26 km SW of Colac P.O., 14.xii.1979, *A.C. Beauglehole 67322* (MEL 1530889); Buckety Plain, c. 5 km ESE of Mt Cope, 12.i.1982, *S.J. Forbes 763* (MEL 612726); Echo Flat, 8 miles ENE of Marysville, 3.ii.1963, *T.B. Muir 2779* (MEL 114537); East Gippsland. Maramingo Creek, Genoa (Maramingo Swamp), 19.xii.1947, *N.A. Wakefield 32B2* (MEL 1508390); Mustering Flat, Mt Baw Baw Plateau, ii.1980, *N.G. Walsh 49S* (MEL S96122); Mt Baw Baw, 24.i.1973, *B. Conn s.n.* (MEL 625677); Carlisle River swamps, xii.1987, *R.J. Bates 13003* (AD 98746532); Bidwell, i.1943, *W. Hunter s.n.* (NSW 182860). **TASMANIA:** Geeveston, i.1901, *A.H.S. Lucas s.n.* (NSW 190371); Longley, xii.1923, *A.H.S. Lucas s.n.* (NSW 190370); Flinders Island, Furneaux Group, Middle Patriarch area c. 1.2 km at 18 deg. NW of the South Patriarch summit, 22.xi.1978, *J.S. Whinray 2510* (MEL 602969); Port Davey, ii.1948, *C. King s.n.* (MEL 114440); Flinders Island, xi.1912, *C.S. Sutton s.n.* (MEL 2016027); Cradle Mountain, i.1914, *R.S. Rogers s.n.* (MEL 2016029); Foot of Mt Arrowsmith, 1.i.191S, *R.A. Black s.n.* (MEL 221586); Vicinity of Cradle Mountain, 10.v.1931, *Weindorfer s.n.* (MEL 114514); North of Triabunna, Bresnehan's property, 29.xii.1969, *M.G. Corrick 2118* (MEL 674291); Between the Arve Rd and the Picton River bridge, 26.xii.1964, *R. Filson 6983* (MEL 646260).

NEW ZEALAND: North Island: Waimarino, i.1921, *H.B. Matthews s.n.* (NSW 182877, NSW 182874, AD 97721005); North Island: Near Frankton Junction, Auckland District, 18.xii.1919, *H.B. Matthews s.n.* (AD 97721010); South Island: Invercargill, *T. Kirk 961* (AD 97605032); Tangiwai, 6.i.1945, *E.D. Hatch s.n.* (AD 97633356); North Island: Tangiwai, i.1945, *E.D. Hatch s.n.* (NSW 182878, AD 98615076); North Island: Near Ruapehu, i.1918, *H.B. Matthews s.n.* (AD 97721008); Hoe-te Lainui Road, Waikato, 6.xii.1958, *R. Mason and N.T. Moar 6770* (CANB 530997); Tangiwui, i.1945, *E.D. Hatch 410* (CANB 536423); South Island: W of Chasm Creek, Seddonville, West Coast, 19.i.1946, *H. Powell s.n.* (NSW 190503); Rukuhia, 1924, *H.B. Matthews s.n.* (NSW 182873); Stewart Island: Freshwater Landing, ii.1947, *C. Smith s.n.* (NSW 3958); Chatham Island, 11.xii.1909, *W.R.B. Oliver s.n.* (WELT 3764, WELT 7274); Stewart Island: Mason Plain, 29.xii.1959, *S. Natusch s.n.* (WELT 78182).

Distribution and habitat: South Australia, New South Wales, Australian Capital Territory, Victoria, Tasmania and New Zealand. Grows in moist sub-alpine herbfield, sphagnum bogs, in heathland along streams and in soaks, in perennially moist substrates such as sphagnum moss, peaty soils and sandy loams. Altitude: 10–1800 m. (Fig. 2b)

Conservation status: Widespread and reasonably common and well conserved throughout much of high altitude south-eastern Australia, but far less common at lower altitudes.

Flowering period: Mostly November to March.

Pollination biology: This species is facultatively autogamous.

***Typification*:** The type sheet contains eight specimens, apparently of the same taxon, with three separate labels. The four specimens on the left (R. Gunn 938), collected at Circular Head in 1837, were selected by Clements (1989) as the lectotype. The group of two specimens in the centre (R. Gunn *s.n.*) and the group of two specimens on the right (R. Gunn 944), both collected at Rocky Cape in 1837, are syntypes. Two rudimentary line drawings in the lower left hand corner of the sheet, probably executed by Lindley, depict a column from the side and rear. The drawing on the left shows the anther beak to be bifid at the apex. Both drawings show the lateral lobes to be incurved (not twisted) and erose at the apex, features not typical of *T. cyanea* and likely to have contributed to later confusion between *T. cyanea* and *T. erosa*.

***Notes*:** *Thelymitra cyanea* is closely related to *T. venosa* from central eastern New South Wales, but the latter is a more robust species that can have as many as eight, generally larger, more freely opening flowers with longer lateral lobes on the column that have more, tighter twists.

3. *Thelymitra erosa* D.L.Jones and M.A.Clem., Contr. Tasman. Orchid.–8, (*Austral. Orchid Res.* 3) 184 (1998).

***Type*:** Tasmania, Burwood Drive area, Blackmans Bay, 17.xi.1994, *J.E. Wapstra ORG57 and A. Wapstra* (holotype CANB!; isotypes AD, HO, MEL2089287!, NSW).

Thelymitra cyanea auct., non (Lindl.) Benth.: L. Rodway. *Tasmanian Fl.*, 189 (1903); W.M. Curtis. *Student's Fl. Tasmania* 4A: 49 (1979).

Illustrations: Firth (1965) page 38, fig. 12 (as *T. cyanea*); Curtis (1979) fig. 5, E (as *T. cyanea*); Jones and Clements (1998) fig. 8.1, a, b and c; Jones *et al.* (1999) pages 260 and 270; Jones (2006) page 250.

Glabrous terrestrial *herb. Tubers* ovoid, 1–3 cm long, 5–13 mm wide, fleshy. *Leaf* linear to linear-lanceolate, 15–30 cm long, 4–10 mm wide, erect, canaliculate to conduplicate, fleshy to leathery, dark green with purplish base, ribbed abaxially, sheathing at base, apex acute. *Scape* 20–50 cm tall, 1.8–3.7 mm diam., slender to somewhat stout, straw-coloured to purplish. *Sterile bracts* usually 2, rarely 1 or 3, linear-lanceolate, 2.5–7 cm long, 5–11 mm wide, closely sheathing, acute to acuminate, green and purplish. *Fertile bracts* ovate-acuminate to obovate-acuminate, 7–23 mm long, 3–10 mm wide, sheathing the pedicel, green or purplish. *Pedicels* 2–24 mm long, slender. *Ovary* narrow-obovoid, 4–14 mm long, 2–4 mm wide. *Flowers* 1–8, (14–)18–30 (–40) mm across, mid-blue to pale purplish or pink with variable darker longitudinal striations, opening freely in warm weather. *Perianth segments* (6–)8–15(–19) mm long, 3–10 mm wide, concave, shortly apiculate; *dorsal sepal* ovate-lanceolate, acute to obtuse; *lateral sepals* ovate-lanceolate, asymmetric, acute to acuminate; *petals* ovate to ovate-lanceolate, acute to obtuse; *labellum* obovate to oblanceolate, often slightly broader than petals, acute to obtuse. *Column* erect from the end of ovary, 4.5–6.5 mm long, 2.5–4 mm wide, broadly winged, white or pale blue; *post-anther lobe* slightly hooding the anther, 1–2.5 mm long, 1.5–2.8 mm wide, reddish brown to almost black, often bilobed, margin

Figure 3. Distribution maps of: a. *Thelymitra erosa*; b. *Thelymitra alpicola* sp. nov.

irregular, sometimes with a central tooth, somewhat sinuate, dorsal surface rugulose, apex yellow or pinkish; *auxiliary lobes* absent; *lateral lobes* parallel or weakly incurved at the apices, 1–2.2 mm long, 0.5–1.1 mm wide, fleshy, obliquely erect or porrect, pink or brownish at base, faces smooth, margins deeply and irregularly erose, apex cream to yellow. *Anther* inserted towards apex of column, ovoid, 2.3–3.7 mm long, 1.5–2.5 mm wide, mostly green, connective produced into an entire or emarginate beak 0.5–1.3 mm long, rugulose; *pollinarium* 1.5–2.7 mm long; *viscidium* more or less circular, 0.3–0.5 mm diam.; *pollinia* white, friable, mealy. *Stigma* situated at base of column, ovate-quadrate, 1.5–2.5 mm long, 1.7–2.5 mm wide, concave, margins irregular. *Capsules* obovoid, 10–18 mm long, 4–8 mm wide, erect, ribbed. (Fig. 1c; 4c)

***Selected specimens examined*: TASMANIA:** Murdunna, Forestier Peninsula, 17.xii.1952, *R. Melville 2454*, *J. Willis*, *H. Barber* and *D. Paton* (MEL S18799); Near The Mount, xii.1985, *R.J. Fensham s.n.* (HO 314898); Roaring Meg Creek, near water supply reservoir, Queenstown, 7.xii.1977, *L.G. Adams* and *C.J. Adams 3377* (HO 111818); Regatta Point, Strahan, 24.xi.1991, *P. Collier 5330* (HO 411310); Surges Bay, 31.x.1992, *H.* and *A. Wapstra s.n.* (HO 500288); Blandfordia Spur, Sisters Hills, 30.xi.1984, *P. Collier 69* (HO 115716); Bicheno, Mobil Service Station, 11.xi.1990, *D.L. Jones 7149* and *C.H. Broers* (HO 326139); Timbertops Ridge, 7.xii.1983, *A.M. Buchanan 1933* (HO 412165); Three Hummock Island. Edge of Telecom Airstrip, 7.xi.1999, *P. Tonelli ORG2B37* (CANB 610977); East end of Rocky Cape National Park, near Sisters Beach boat ramp (Blackboy Hill), 31.x.1998, *D.L. Jones 16027* and *M. Garratt* (CANB 605660).

Distribution and habitat: Apparently endemic to Tasmania where sometimes common in heathlands, woodlands and heathy, grassy or sedgy open forest. Soils are sandy or peaty loams. Often favours disturbed areas such as road sides and gravel pits. Altitude: 0–600 m. (Fig. 3a)

Conservation status: Widespread, often locally common and well conserved.

Flowering period: Late October to December.

Pollination biology: This species is facultatively autogamous. Most flowers usually have pollen grains on the stigma even before they open.

Notes: *Thelymitra erosa* shows considerable variation across its range, particularly in terms of the degree of venation of the perianth. Typical specimens have the perianth mid-blue to purplish or pink with variable darker purplish longitudinal striations. The lateral lobes of the column are more or less flat and parallel (or with the very tips slightly incurved), broad at the base and with deeply toothed to erose margins. *Thelymitra incurva* from far eastern Victoria and south-east New South Wales has a plain pale blue or pink perianth. The lateral lobes are often concave and strongly incurved throughout, broad at the base and with irregular but not deeply incised margins. *Thelymitra alpicola* from the margins of snow plains and montane heathlands in mainland south-eastern Australia has flowers that are deep purplish blue with very strong dark purplish longitudinal striations. The lateral lobes are more or less flat and parallel (apices sometimes incurved), often

narrow throughout and with irregularly erose but not deeply incised margins.

Thelymitra erosa has been confused with *T. cyanea* but the latter grows in wetter habitats, has a strongly differentiated labellum, the lateral lobes of the column are spirally twisted and lack erose margins and the anther beak is much more obviously bifid at the apex.

4. *Thelymitra alpicola* Jeanes *sp. nov.*

Type: Victoria. Snowfields Region: Rocky Plain, c. 20km NW of Wulgulmerang, 23.xii.2000, *D. Rouse JAJ986* (holotype MEL 2096100; isotypes MEL 2096101 spirit, CANB).

Thelymitra cyanea auct., non (Lindl.) Benth.: J.H. Willis. *Handb. Pl. Victoria*, 1: 352 (1962) *p.p.*; W.H. Nicholls. *Orchids of Australia*. 12 (1969) *p.p.*

Thelymitra pulchella auct., non Hook.f.: M.A. Clements. Catalogue of Australian Orchidaceae, *Austral. Orchid Res.* 1, 142 (1989); J.Z. Weber and T.J. Entwisle in N.G. Walsh and T.J. Entwisle eds, *Flora of Victoria*, 2: 853 (1994); G.N. Backhouse and J.A. Jeanes. *The Orchids of Victoria*. 357 (1995).

Illustrations: Nicholls (1951) plate 50 (as *T. cyanea*); Nicholls (1969) plate 51 (as *T. cyanea*); Bernhardt (1993) page 151 (as *T. pulchella*); Weber and Entwisle (1994) fig. 179, o and p (as *T. pulchella*); Backhouse and Jeanes (1995) page 357 (as *T. pulchella*); Bishop (2000) plate 47; Jeanes and Backhouse (2000) page 161 (as *T.* sp. aff. *erosa*); Jeanes and Backhouse (2006) page 197 (as *T. erosa* ssp. 2); Jones (2006) page 249.

Glabrous terrestrial *herb*. *Tubers* ovoid, 1–3 cm long, 5–13 mm wide, fleshy. *Leaf* linear to linear-lanceolate, 6–25 cm long, 4–13 mm wide, erect, canaliculate to conduplicate, fleshy to leathery, dark green with purplish base, ribbed abaxially, sheathing at base, apex acute. *Scape* 15–50 cm tall, 1–3.7 mm diam., slender to somewhat stout, straw-coloured to purplish. *Sterile bracts* usually 2, rarely 1 or 3, linear-lanceolate, 1.5–8.5 cm long, 3–12 mm wide, closely sheathing, acute to acuminate, green and purplish. *Fertile bracts* ovate-acuminate to obovate-acuminate, 6.5–25 mm long, 3–10 mm wide, sheathing the pedicel, green or purplish. *Pedicels* 3–18 mm long, slender. *Ovary* narrow-obovoid, 5–13 mm long, 1.5–4 mm wide. *Flowers* 1–6, (15–)18–30(–34) mm across, deep purplish blue with darker longitudinal striations, opening freely in warm weather. *Perianth segments* (7–)8–14(–16) mm long, 3–8 mm wide, concave, shortly apiculate; *dorsal sepal* ovate-lanceolate, acute to obtuse; *lateral sepals* ovate-lanceolate, asymmetric, acute to acuminate; *petals* ovate to ovate-lanceolate, acute to obtuse; *labellum* obovate to oblanceolate, often slightly broader than petals, acute to obtuse. *Column* erect from the end of ovary, 4.5–6.5 mm long, 2.5–3.7 mm wide, broadly winged, purplish; *post-anther lobe* slightly hooding the anther, 1–2.5 mm long, 1.5–2.5 mm wide, reddish brown to almost black, often bilobed, margin irregular, sometimes with a central tooth, somewhat sinuate, dorsal surface rugulose, apex yellow or pinkish; *auxiliary lobes* absent; *lateral lobes* parallel or weakly incurved at the apices, 1–2.2 mm long, 0.3–1.1 mm wide, fleshy, obliquely erect or porrect, pink or brownish at base, faces smooth, margins often shallowly and irregularly erose, apex cream to yellow. *Anther* inserted towards apex of column, ovoid, 2.3–3.7 mm long, 1.5–2.5 mm wide, mostly green, connective produced into an entire or emarginate beak 0.5–1.3 mm long, rugulose; *pollinarium* 1.5–2.7 mm long; *viscidium* more or less circular, 0.3–0.5 mm diam.; *pollinia* white, friable, mealy. *Stigma* situated at base of column, ovate-quadrate, 1.5–2.5 mm long, 1.7–2.5 mm wide, concave, margins irregular. *Capsules* obovoid, 10–18 mm long, 4–8 mm wide, erect, ribbed. (Fig. 1d; 4d)

***Selected specimens examined*: NEW SOUTH WALES:** Providence Portal turnoff on Snowy Mountains Highway, N side, 19.xii.1991, *A.D. Bishop J182/21-28* (NSW 430475); Approx. 1.5 km E of Numeralla–Braidwood Road. N edge of Badja Swamps Nature Reserve, 16.xii.1991, *A.D. Bishop J1B1/9-16* (NSW 430049); Southern Tablelands: 10 km W of Adaminaby, 23.xi.1981, *J. Taylor 1392* (CANB 8200984); Southern Tablelands: c. 15 miles from Braidwood on road to Batemans Bay, 28.xii.1966, *R. Nash s.n.* (CANB 8109628); 8adja, 6.i.1950, *E. Gauba s.n.* (CAN8 14374); Clyde Mountain, top of pass on Batemans Bay–Braidwood Road, 28.xii.1966, *R. Nash s.n.* (CANB 176756); Southern Tablelands: Kosciusko National Park; Providence Portal turnoff on track to Kiandra from Adaminaby, 21.xii.1985, *M.A. Clements 3929* (CANB 8585581); Boggy Creek Plains, xii.1987, *R.J. Bates 13492* (AD RJB13492); Kanangra 8oyd National Park. Kowmung River Trail, 9.xii.2000, *D. Rouse* and *J. Riley JAJ823* (MEL 2172985); Oberon–Jenolan Caves Road, c. 0.7 km W of Goulburn turnoff and c. 3.7 km W of Kanangra Walls Road, 9.xii.2000, *D. Rouse and J. Riley JAJ825* (MEL 2172973).

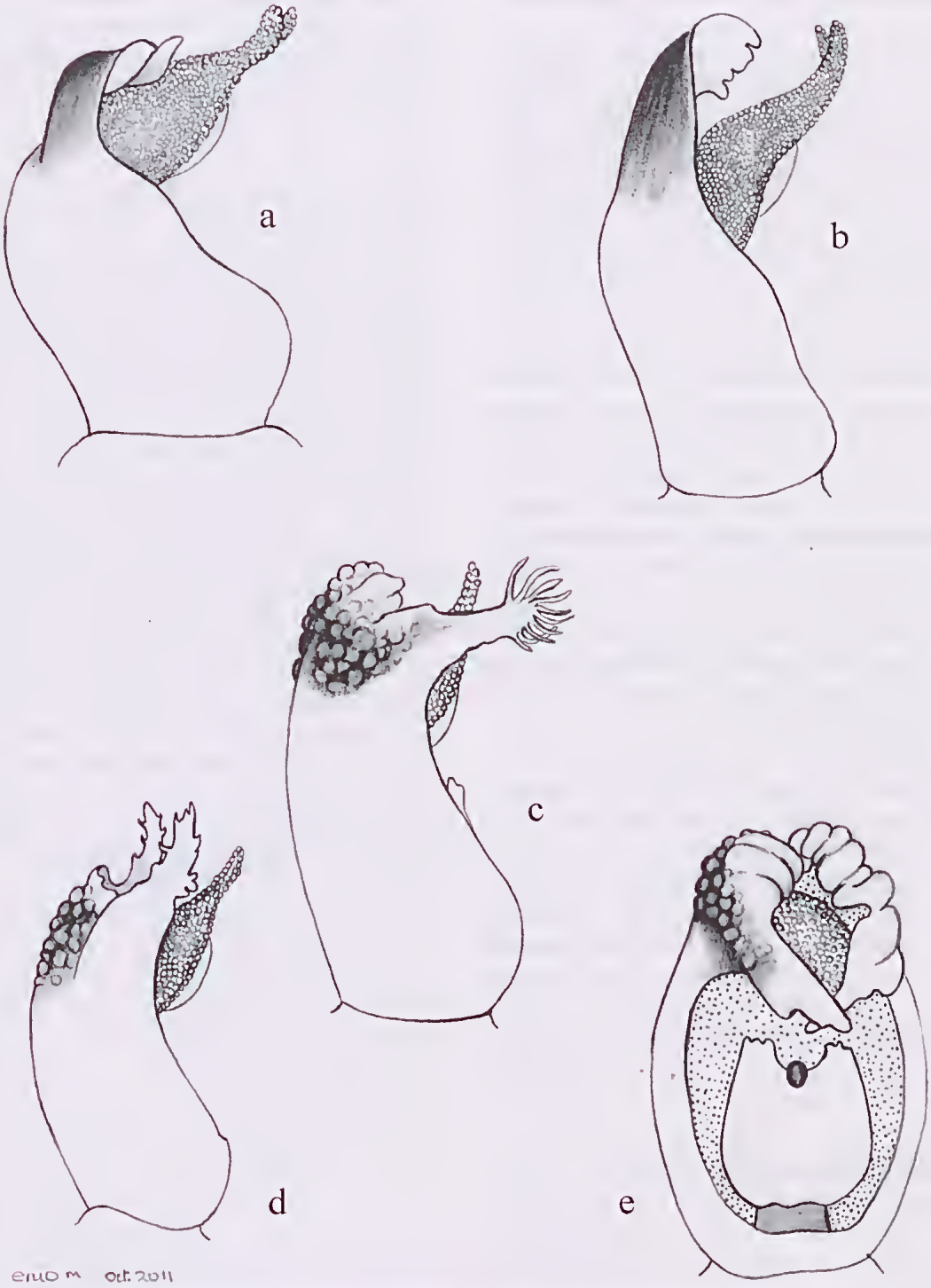

Figure 4. Illustrations of columns of: a. *Thelymitra venosa*; b. *Thelymitra cyanea*; c. *Thelymitra erosa*; d. *Thelymitra alpicola* sp. nov.; e. *Thelymitra incurva* sp. nov.

VICTORIA: Bidwell, 2.i.1943, *W. Hunter s.n.* (MEL 1532509, MEL 1532516, MEL 2098522); East Gippsland. Rocky Plain, 6.i.1971, *A.C. Beauglehole 35889* and *K.C. Rogers* (MEL 652440); Bidwell Creek, i.1943, *W. Hunter s.n.* (NSW 415957); Bidwell, Bendoc, i.1943, *W. Hunter s.n.* (NSW 465642); Rocky Plain, c. 20 km NW of Wulgulmerang, 23.xii.2000, *D. Rouse JAJ986* (MEL 2096100, MEL 2096101); Darlimurla near Mirboo North, Gippsland, 29.x.1999, *J.A. Jeanes 635* (MEL 2173009); Darlimurla near Mirboo North, Gippsland, 8.xi.2000, *J.A. Jeanes 938* (MEL 2172983); Long Flat, opposite the start of Forlorn Hope Track, 23.xii.2000, *D. Rouse JAJ987* (MEL 2173007); Dingo Flat at Wombargo Saddle, c. 20 km NW of Wulgulmerang, 6.i.1991, *J.A. Jeanes 715* (MEL 2173008).

Distribution and habitat: New South Wales and Victoria. Grows in alpine and montane heathlands, in moist areas around the edges of sphagnum bogs, beside streams or in soaks and swamps. A population in the Strzelecki Ranges Victoria is noteworthy for its disjunction and low altitude. Soils are generally dark sandy, clayey or peaty loams. Altitude: (200–)1000–1700 m. (Fig. 3b).

Conservation status: Widespread and sometimes locally common but overall vulnerable. Suggest 3VC by criteria of Briggs and Leigh (1996) and Vulnerable (VU) by criteria of IUCN (2011).

Flowering period: Late October to January.

Pollination biology: This species is facultatively autogamous. Most flowers usually have pollen grains on the stigma even before they open.

Notes: *Thelymitra alpicola* can be distinguished from *T. erosa* and *T. incurva* by its deep purplish blue, strongly striated perianth and more or less parallel (sometimes incurved at apices), often narrow, shallowly erose, lateral lobes on the column.

Etymology: Latin *alpinus*, of the alps; *cola*, dweller; in reference to the alpine or sub-alpine habitats where this species is most often found.

5. *Thelymitra incurva* Jeanes *sp. nov.*

Type: Victoria. East Gippsland Region: East Wingan Road c. 1.3 km from the Princes Highway, 11.xi.2004, *J.A. Jeanes 1451* (holotype MEL 2265101; isotype MEL 2265104 spirit).

Thelymitra cyanea auct., non (Lindl.) Benth.: J.H. Willis. *Handb. Pl. Victoria*, 1: 352 (1962) *p.p.*; W.H. Nicholls. *Orchids of Australia*. 12 (1969) *p.p.*

Illustrations: Weber and Entwisle (1994) fig. 179, q (as *T. pulchella*); Backhouse and Jeanes (1995) page 358 (as *T.* sp. aff. *pulchella*); Jeanes and Backhouse (2000) page 161 (as *T. erosa*); Jeanes and Backhouse (2006) page 197 (as *T. erosa* ssp. 1); Jones (2006) page 250.

Glabrous terrestrial *herb*. *Tubers* ovoid, 1–3 cm long, 5–13 mm wide, fleshy. *Leaf* linear to linear-lanceolate, 10–20 cm long, 4–9 mm wide, erect, canaliculate to conduplicate, fleshy to leathery, dark green with purplish base, ribbed abaxially, sheathing at base, apex acute. *Scape* 20–65 cm tall, 1.2–3 mm diam., slender to somewhat stout, straw-coloured to purplish. *Sterile bracts* usually 2, rarely 1 or 3, linear-lanceolate, 2.5–10 cm long, 4–10 mm wide, closely sheathing, acute to acuminate, green and purplish. *Fertile bracts* ovate-acuminate to obovate-acuminate, 5–21 mm long, 3–7 mm wide, sheathing the pedicel, green or purplish. *Pedicels* 2–10 mm long, slender. *Ovary* narrow-obovoid, 5–10 mm long, 2–3.5 mm wide. *Flowers* 1–7, (15–)18–25 mm across, pale blue or rarely pink, lacking obvious darker longitudinal striations, opening freely in warm weather. *Perianth segments* (7–)8–12 mm long, 3–7 mm wide, concave, shortly apiculate; *dorsal sepal* ovate-lanceolate, acute to obtuse; *lateral sepals* ovate-lanceolate, asymmetric, acute to acuminate; *petals* ovate to ovate-lanceolate, acute to obtuse; *labellum* obovate to oblanceolate, often slightly broader than

Figure 5. Distribution map of *Thelymitra incurva* sp. nov.

petals, acute to obtuse. *Column* erect from the end of ovary, 4–5.5 mm long, 2.5–3.5 mm wide, broadly winged, pale blue; *post-anther lobe* slightly hooding the anther, 1.5–2 mm long, 1.5–2.2 mm wide, reddish brown to almost black, often bilobed, margin thickened, irregular, sometimes with a central tooth, somewhat sinuate, dorsal surface rugulose, apex yellow or pinkish; *auxiliary lobes* absent; *lateral lobes* usually strongly incurved throughout, 1.5–2 mm long, 0.5–1 mm wide, fleshy, often concave, obliquely erect or porrect, pink or brownish at base, faces smooth, margins often shallowly and irregularly erose, apices often touching below tip of anther beak, cream to yellow. *Anther* inserted towards apex of column, ovoid, 2.3–3.7 mm long, 1.5–2.5 mm wide, mostly green, connective produced into an entire or emarginate beak 0.5–1.3 mm long, rugulose; *pollinarium* 1.5–2.7 mm long; *viscidium* more or less circular, 0.3–0.5 mm diam.; *pollinia* white, friable, mealy. *Stigma* situated at base of column, ovate-quadrate, 1.5–2.5 mm long, 1.7–2.5 mm wide, concave, margins irregular. *Capsules* obovoid, 10–18 mm long, 4–8 mm wide, erect, ribbed. (Fig. 1e; 4e)

Specimens examined: **NEW SOUTH WALES:** Nadgee Nature Reserve, 9.xi.2004, *J.A. Jeones 1446* (MEL 2265087, MEL 2265088). **VICTORIA:** East Gippsland Region. Beside East Wingan Rd, c. 600 m SE of the Princes Highway and c. 27 km E of Cann River township, 15.xi.1991, *J.A. Jeones 4* (MEL 2011685); East Gippsland c. 5.5 miles direct NE of Mallacoota P.O. c. 2 miles S of Marshmead property on track to Lake View, 8.xi.1969, *A.C. Beauglehole 31579* and *J.H. Willis* (MEL 114553); East Wingan Road, W of Genoa, 17.xi.1992, *A.D. Bishop J245/13-17* (NSW 430839); Far East Gippsland, 2 miles S of Marshmead, E of Mallacoota National Park, x.1969, *J.H. Willis s.n. ond A.C. Beauglehole* (MEL 2039740); East Gippsland Region: Genoa. Grasstree plains near intersection of Princes Hwy and East Wingan Rd., 15.xi.1991, *J.A. Jeones s.n.* (MEL 2046931); East Gippsland Region. Beside East Wingan Rd, c. 600 m SE of the Princes Highway and c. 27 km E of Cann River township, 15.xi.1991, *J.A. Jeones 337* (MEL 2172979).

Distribution and habitat: Far eastern Victoria and south-eastern New South Wales. Grows in heathlands and heathy woodlands mostly around the edges of grasstree (*Xanthorrhoea resinosa*) plains, often in disturbed sites such as roadsides and gravel scrapes. Soils are moist coarse sandy, peaty loams. Altitude: 40–100 m. (Fig. 5)

Conservation status: Currently known from about six sites with very few plants and probably endangered. Suggest 2EC by criteria of Briggs and Leigh (1996) and Endangered (EN) by criteria of IUCN (2011).

Flowering period: Late October to early December.

Pollination biology: This species is facultatively autogamous. Most flowers usually have pollen grains on the stigma even before they open.

Notes: *Thelymitra incurva* can be distinguished from *T. erosa* and *T. alpicola* by its plain, pale blue (rarely pink) flowers and strongly incurved, broad, often concave, shallowly erose lateral lobes on the column.

Etymology: Latin *incurvus*, curved, crooked; a reference to the lateral lobes of the column that are usually strongly incurved throughout.

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References

Backhouse, G.N. and Jeanes, J.A. (1995). *The Orchids of Victorio*. Melbourne University Press: Carlton.

Bentham, G. (1873). *Floro Australiensis*, vol. 6. L. Reeve & Co.: London.

Bernhardt, P. (1993). *'Thelymitro'*, in G.W.Harden (ed.), *Floro of New South Woles* 4, New South Wales University Press: Kensington.

Bishop, A. (2000). *Field Guide to the Orchids of New South Woles ond Victorio*, 2nd edition. University of New South Wales Press: Sydney.

Black, J.M. (1922). *Floro of South Austrolio* part 1. Government Printer: Adelaide.

Briggs, J.D. and Leigh, J.H. (1996). *Rore or Threotened Austrolion Plonts* (revised edn). CSIRO and Australian Nature Conservation Agency: Canberra.

Brown, R. (1810). *Prodromus Floroe Novoe Hollondioe et Insuloe von Diemen*. London.

Clements, M.A. (1989). Catalogue of Australian Orchidaceae, *Austrolion Orchid Reseorch* **1**, 1–160.

Curtis, W.M. (1979). *The Student's Flora af Tosmania* part 4A. Government Printer: Hobart.

Ewart, A.J. (1931). *Flara of Victoria.* Government Printer: Melbourne.

Firth, M.J. (1965). *Native Orchids af Tosmania.* C.L.Richmand and Sans Pty. Ltd.: Devonport.

Gray, C.E. (1966). *Victorion Native Orchids*, val. 1. Langmans: Victaria.

Gray, C.E. (1971). *Victorion Native Orchids*, vol. 2. Langman: Victaria.

Hatch, E.D. (1952). The New Zealand forms of *Thelymitra* J.R. and G.Farster and appendices, part 1, *Trans. & Proc. Roy. Soc. New Zealand* **79**, 386–401.

Haaker, J.D. (1858). *Flora Tasmaniae*, val. 2. Lovell Reeve: Covent Garden.

IUCN (2011). *IUCN Red List of Threotened Species. Versian 2011.1* <http://www.iucnredlist.org. Downlaaded on 16 June 2011.

Jeanes, J.A. and Backhouse, G.N. (2000). *Wild Orchids af Victario, Australia.* Zoonetics: Seaford.

Jeanes, J.A. and Backhouse, G.N. (2006). *Wild Orchids af Victoria, Austrolio.* Aquatic Photographics: Seafard.

Janes, D.L. (1988). *Native Orchids of Austrolio.* Reed Books: Frenchs Forest.

Janes, D.L. (2006). *Notive Orchids of Australio.* Reed New Halland: Sydney.

Janes, D.L. and Clements, M.A. (1998). Contributions ta Tasmanian Orchidalogy – 8: A Taxonamic Review of *Thelymitro* J.R. & G. Forst. in Tasmania, *Austrolian Orchid Reseorch* **3**, 178–203.

Jones, D.L., Wapstra, H., Tanelli, P. and Harris, S. (1999). *The Orchids of Tasmanio.* Melbaurne University Press: Carltan.

Lindley, J. (1839–40). *A Sketch of the Vegetotion af the Swan River Calony.* Appendix ta the first 23 volumes af Edwards's Batanical Register.

Lindley, J. (1840). *The Genera and Species af Orchidaceaus Plants.* Ridgways: Landan.

Mueller, F. (1882). *Systematic Census af Austrolion Plants.* M'Carron, Bird & Co.: Melbourne.

Nash, R.C. (1968). Some Interesting Carrespandence, *The Orchodion* **2(10)**, 128.

Nicholls, W.H. (1935). The Sun Orchids af Australia, *Orchidalagia Zeylonica* **2(4)**, 157.

Nicholls, W.H. (1951). *Orchids af Australia*, part 3. Geargian House: Melbaurne.

Nicholls, W.H. (1969). *Orchids of Australia, the camplete editian* (eds D.L. Jones and T.B. Muir). Thomas Nelson: Melbourne.

Reichenbach, H.G. (1871). *Beiträge zur Systemotischen Pflanzenkunde*. Hamburg.

Rodway, L. (1903). *The Tosmonian Floro.* Gavernment Printer: Hobart.

Rogers, R.S. (1911). *An Intraduction to the Study of South Australion Orchids*, edn 2. Government Printer: Adelaide.

Rupp. H.M.R. (1939). A Beautiful N.S.W. Ground Orchid, *Australian Orchid Review* **4**, 81.

Rupp, H.M.R. (1943). *The Orchids of New Sauth Wales.* Australasian Medical Publishing Company Limited: Glebe.

St George, I. (1999). *The Noture Guide ta New Zealond Native Orchids.* Random House: Auckland.

St George, I., Irwin, B. and Hatch, D. (1996). *Field Guide ta the New Zealond Orchids.* New Zealand Native Orchid Graup: Wellington.

Weber, J.Z. and Entwisle, T.J. (1994). '*Thelymitro*', in N.G.Walsh and T.J.Entwisle (eds), *Floro af Victoria* **2**, 840–854. Inkata Press: Melbourne.

Willis, J.H. (1962). *A Hondbaok ta Plonts in Victoria*, val. 1. Melbourne University Press: Parkville.

New combinations in *Callistemon* (Myrtaceae)

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Introduction

Morphological and molecular studies of genera in the tribe Melaleuceae *sensu* Wilson *et al.* (2005) have extended our knowledge of the phylogeny of the group, but failed to resolve their classification (see Briggs & Johnson 1979; Johnson & Briggs 1983; Johnson & Briggs 1984; Gravolin 1997; Ladiges *et al.* 1999; Orlovich *et al.* 1999; O'Brien *et al.* 2000; Brown *et al.* 2001). Craven (2006) sank *Callistemon* into *Melaleuca*, and provided combinations in *Melaleuca* for Australian species of *Callistemon*. Subsequently, Craven (2009) described several new species of *Melaleuca* that would previously have been placed in *Callistemon*. No combinations exist for these taxa in *Callistemon*. Australian herbaria are divided in their recognition of *Callistemon*, with state herbaria in New South Wales, Victoria, South Australia and Western Australia following the Australian Plant Census (APC 2011) in recognising *Callistemon*, whilst the other state herbaria in Queensland, Northern Territory, Australian Capital Territory, and Tasmania, treat the relevant taxa in *Melaleuca*.

Studies of nuclear 5S and IT5-1 DNA (Ladiges *et al.* 1999; Brown *et al.* 2001), and a combined study of morphology and chloroplast *ndh*F DNA (Edwards *et al.* 2010) have shown that *Melaleuca* is polyphyletic, genera of the monophyletic tribe Melaleuceae being nested within it. Edwards *et al.* (2010) pointed out that this presented a classic 'split-or-sink' dilemma. They noted that although molecular studies had indicated three major clades within the tribe 'no morphological support or diagnostic synapomorphies are identified for any of these clades' and therefore because 'the circumscription of *Melaleuca* and the generic status of other genera within Melaleuceae, is poorly supported' they proposed 'that all genera within the Melaleuceae are synonymised with *Melaleuca*' (Edwards *et al.* 2010). The difficulty of finding morphological characters to uniquely define what could potentially be many new segregate genera with few representatives gave further support for this decision.

The genera of tribe Melaleuceae *sensu* Wilson *et al.* (2005) are: *Callistemon* (c. 35 spp.), *Conothamnus* (3 spp.), *Lamarchea* (2 spp.), *Melaleuca* (c. 220 spp.), *Beaufortia* (15 spp.), *Calothamnus* (38 spp.), *Eremaea* (15 spp.), *Phymatocarpus* (3 spp.) and *Regelia* (6 spp.). Edwards *et al.* (2010) note that Melaleuceae have never been formally defined

Abstract

Recent phylogenetic studies have investiga ted the tribe Melaleuceae and, in particular, the degree of 'inclusiveness' of the genus *Melaleuca*, but the results remain open to interpretation. State herbaria in Australia are, for example, divided over the proposal to subsume *Callistemon* into *Melaleuca*. A proposal to sink all genera of tribe Melaleuceae into a broadly defined *Melaleuca* appears premature without corroboration from further research and discussion of possible alternatives. New combinations in *Callistemon* are therefore provided for nine species and three subspecies of *Melaleuca*.

Keywords: *Callistemon*, *Melaleuca*, Melaleuceae, Myrtaceae

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morphologically and, given the homoplasious nature of the morphological characters surveyed in their study, the situation appears no closer to resolution.

Edwards *et al.* (2010) justify the sinking of *Callistemon* on the basis of non-monophyly demonstrated by cpDNA alone. A decision based on this evidence seems premature, especially as their combined analysis, with morphology included, and studies based on nuclear DNA (Ladiges *et al.* 1999; Brown *et al.* 2001), recovered a monophyletic Australian *Callistemon*. The analysis of Edwards *et al.* (2010) contained relatively few samples of *Callistemon* and GenBank accession numbers were given for only a small proportion of taxa in that study precluding the independent verification of *ndh*F sequences and their resulting phylogenies. We therefore concur with Brown *et al.* (2001) that, Australian species should be retained in *Callistemon*, and that monophyletic groups may need to be formally recognised within *Melaleuca*, preferably with morphological characters to diagnose the main clades.

If all genera of the Melaleuceae are subsumed within *Melaleuca* then this aggregate genus would itself have no morphological characters to uniquely define it, thereby failing a major criterion used to justify the proposed synonymy. Further, the conclusion that, '... current species-poor genera may retain recognition at the subgeneric level' (Edwards *et al.* 2010), simply transfers this difficulty to a lower rank, raising the possibility of a polyphyletic subgenus *Melaleuca* that cannot be morphologically defined.

We consider that, in spite of clear difficulties in resolving these issues, current evidence is insufficient to justify the proposal to synonymise all genera of Melaleuceae, and more molecular and morphological evidence is required. Accordingly, the following new combinations are provided for Australian species of *Callistemon* currently placed in *Melaleuca*. For readers' reference we have listed phrase names recognised in the Australian Plant Name Index (APNI 2011) as synonyms. Full synonymy is available in Craven (2009).

Taxonomy

Callistemon hemistictus* (S.T.Blake ex Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca hemisticta* S.T.Blake ex Craven, *Novon* 19: 444–445 (2009).

Callistemon lazaridis* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca lazaridis* Craven, *Novon* 19: 445–446 (2009).

Callistemon megalongensis* (Craven & S.M.Douglas) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca megalongensis* Craven & S.M.Douglas, *Novon* 19: 446–447 (2009).

Synonym: *Callistemon* sp. Megalong Valley (Craven, Mallison & Douglas 10442) NSW Herbarium

Callistemon montis-zamiae* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca montis-zamiae* Craven, *Novon* 19: 447 (2009).

Callistemon phratra* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca phratra* Craven, *Novon* 19: 447–448 (2009).

***Callistemon pungens* Lumley & R.D.Spencer**

Synonym: *Melaleuca williamsii* Craven

Callistemon pungens* subsp. *pungens

Callistemon pungens* subsp. *fletcheri* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca williamsii* subsp. *fletcheri* Craven, *Novon* 19: 451–452 (2009).

Synonym: *Callistemon pungens* subsp. Fletcheri (P.F.Lumley 1120) Australian National Herbarium

Callistemon pungens* subsp. *synoriensis* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca williamsii* subsp. *synoriensis* Craven, *Novon* 19: 452–453 (2009).

Synonym: *Callistemon* sp. Gibraltar Range (R.Johnstone 1738) NSW Herbarium

Callistemon pyramidalis* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca pyramidalis* Craven, *Novon* 19: 448–449 (2009).

Callistemon quercinus* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca quercina* Craven, *Novon* 19: 449 (2009).

Callistemon sabrina* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca sabrina* Craven, *Novon* 19: 449–450 (2009).

Callistemon serpentinus* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca serpentina* Craven, *Novon* 19: 450–451 (2009).

***Callistemon viminalis* (Solander ex Gaertner) G.Don**

Callistemon viminalis* subsp. *viminalis

Callistemon viminalis* subsp. *rhododendron* (Craven) Udovicic & R.D.Spencer, *comb. nov.

Basionym: *Melaleuca viminalis* subsp. *rhododendron* Craven, *Novon* 19: 451 (2009).

Synonym: *Callistemon viminalis* subsp. Rhododendron (W.Stanford *s.n.* CANB 780382) Australian National Herbarium

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References

APC (2011). *Australian Plant Census*, IBIS database. Centre for Plant Biodiversity Research, Council of Heads of Australasian Herbaria. Accessed 23 June, 2011. [http://www.anbg.gov.au/chah/apc].

APNI (2011). *Australian Plant Name Index*, IBIS database. Centre for Plant Biodiversity Research, Canberra. Accessed 23 June, 2011. [http://www.anbg.gov.au/cgi-bin/apni].

Briggs, B.G. and Johnson, L.A.S. (1979). Evolution in the Myrtaceae-evidence from inflorescence structure. *Proceedings of the Linnean Society of New South Wales Series 2* **102**, 157–256.

Brown, G.K., Udovicic, F. and Ladiges, P.Y. (2001). Molecular phylogeny and biogeography of *Melaleuca*, *Callistemon* and related genera (Myrtaceae). *Australian Systematic Botany* **14**, 565–585.

Craven, L.A. (2006). New combinations in *Melaleuca* for Australian species of *Callistemon* (Myrtaceae). *Novon: A Journal for Botanical Nomenclature* **16**, 468–475.

Craven, L.A. (2009). *Melaleuca* (Myrtaceae) from Australia. *Novon: A Journal for Botanical Nomenclature* **19**, 444–453.

Edwards, R.D., Craven, L.A., Crisp, M.D. and Cook, L.G. (2010). *Melaleuca* revisited: cpDNA and morphological data confirm that *Melaleuca* L. (Myrtaceae) is not monophyletic. *Taxon* **59**, 744–754.

Gravolin, M. (1997). Stigmas, stamens and systematics: floral morphology of the *Beaufortia* suballiance (Myrtaceae). BSc (Hons) Thesis, School of Botany, The University of Melbourne.

Johnson, L.A.S. and Briggs, B.G. (1983). 'Myrtaceae'. In B.D. Morley and H.R. Toelken (eds), Flowering Plants in Australia, pp. 175–185. Rigby: Adelaide.

Johnson, L.A.S. and Briggs, B.G. (1984). Myrtales and Myrtaceae – A phylogenetic analysis. *Annals of the Missouri Botanical Garden* **71**, 700–756.

Ladiges, P.Y., McFadden, G.I., Middleton, N., Orlovich, D.A., Treloar, N. and Udovicic, F. (1999). Phylogeny of *Melaleuca*, *Callistemon*, and related genera of the *Beaufortia* suballiance (Myrtaceae) based on 5S and ITS-1 spacer regions of nrDNA. *Cladistics* **15**, 151–172.

O'Brien, M.M., Quinn, C.J. and Wilson, P.G. (2000). Molecular systematics of the *Leptospermum* suballiance (Myrtaceae). *Australian Journal of Botany* **48**, 621–628.

Orlovich, D.A., Drinnan, A.N. and Ladiges, P.Y. (1999). Floral development in *Melaleuca* and *Callistemon* (Myrtaceae). *Australian Systematic Botany* **11**, 689–710.

Wilson, P.G., O'Brien, M.M., Heslewood, M.M. and Quinn, C.J. (2005). Relationships within Myrtaceae *sensu lato* based on a *mat*K phylogeny. *Plant Systematics and Evolution* **251**, 3–19.

Revision of the *Spyridium bifidum* – *S. halmaturinum* complex (Rhamnaceae: Pomaderreae) from South Australia and Victoria

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Abstract

The *Spyridium bifidum* – *S. halmoturinum* complex is revised; it consists of eight species and two subspecies. *Spyridium bifidum*, *S. coactilifolium* and *S. holmaturinum* are maintained in revised circumscription. New combinations and names are provided for *S. bifidum* subsp. *wonilloe*, *S. coolitum* and *S. scobridum*. *Spyridium stenophyllum* is re-instated and transferred from *Cryptondro* to *Spyridium*. The following taxa are published as new: *S. fontis-woodii*, *S. furculentum* and *S. stenophyllum* subsp. *renovatum*, the last of which contains most specimens previously referred to as *S. bifidum*. All taxa are described, illustrated and typified; distribution maps are provided.

Keywords: Australia, taxonomy, nomenclature, Rhamnaceae, Pomaderreae, *Spyridium*.

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Introduction

Spyridium Fenzl. is one of the larger genera of Rhamnaceae in Australia. Comprising about 45 species, it is the third largest genus of the Pomaderreae, a tribe endemic to Australia and New Zealand (Kellermann *et al.* 2005; Kellermann & Udovicic 2008). The genus occurs in temperate and semi-arid south-western and south-eastern Australia. Its main centre of distribution is in South Australia (currently 20 species), with a secondary centre in Western Australia (15 species). Only two species are shared between western and south-eastern Australia. There are eight species of *Spyridium* in Victoria, half shared with South Australia, six species in New South Wales, one extending into south-eastern Queensland, and eight species in Tasmania (see Lepschi *et al.* 2011).

The last treatment of *Spyridium* for South Australia (Canning 1986) recognised 14 species and six infraspecific taxa. Apart from the addition of *S. nitidum* Wakef. and *S. tridentatum* (Steud.) Benth., Canning's (1986) treatment repeated that by Black (1926, 1952) with a few minor amendments. Since 1986 there have been several changes: *Spyridium tridentatum* has been transferred back into the re-established genus *Stenanthemum* Reissek (Rye 1995a; Barker 2005; Thiele 2007) as *St. tridentatum* (Steud.) Reissek; *Spyridium tricolor* W.R.Barker & Rye and *S. erymnocladum* W.R.Barker have been newly described (Barker & Rye 1993, Barker 1995), and *S. waterhousei* F.Muell., which had been long subsumed under *Cryptandra* Sm., has been re-instated (Kellermann 2007b).

The last *Spyridium* treatment for Victoria (Walsh 1999) included seven species, one of which was not published at the time: *Spyridium* sp. 1. Two species endemic to the Grampians were later transferred from *Trymalium* to *Spyridium* (Kellermann 2006b): *S. daltonii* (F.Muell.) Kellermann and *S.* ×*ramosissimum* (Audas) Kellermann.

This paper revises the *S. bifidum – S. halmaturinum* complex, which mainly occurs in South Australia, but also has one taxon endemic to Victoria.

Taxonomic history and discussion

In the treatments of Black (1926, 1952) and Canning (1986) the *Spyridium bifidum – S. halmaturinum* species complex comprised two widespread polymorphic species, *S. bifidum* (F.Muell.) Benth., largely of mainland South Australia and *S. halmaturinum* (F.Muell.) Benth. of Kangaroo Island, and a third species restricted to the vicinity of Victor Harbor, *S. coactilifolium* Reissek. The two former species each contained several varieties. This treatment of the complex has been unsatisfactory as several distinctive taxa with bilobed or emarginate leaves have been referred to as '*Spyridium bifidum*', while three varieties with the same epithet '*integrifolium*' have been used for entire-leaved variants of these bilobed taxa.

The complex is here divided into two main groups of taxa allied with *S. bifidum* and *S. halmaturinum*, following traditional application of the names.

The *Spyridium bifidum* group

The first taxon to be described in this group was *Trymalium bifidum* by Mueller (1855) from specimens collected by Carl Wilhelmi on the Eyre Peninsula at Boston Point, just north of Port Lincoln, and at Marble Range. Reissek (1858) split Mueller's *T. bifidum* into two species, describing the Boston Point collection as *T. stenophyllum*. He characterised this new species as being more slender and having glabrous upper surfaces of the leaves.

Our observations confirm that specimens from these two localities, only c. 50 km apart, are superficially similar on account of the Y-shaped leaves and stipules that are fused for more than half of their length. However, the populations at Marble Range differ in several characters, such as the presence of simple hairs on the upper surface of the leaves and very large, globular, head-like inflorescences. In comparison, the coastal taxon has narrower, glabrous leaves and smaller inflorescences. Furthermore, specimens from Boston Point have bifid stigmas and bicarpellate ovaries, in contrast to the Marble Range specimens, which have trifid stigmas and trilocular ovaries.

Later authors, including Bentham (1863), who transferred *Trymalium bifidum* to *Spyridium*, Black (1926, 1952) and Canning (1986), only accepted *S. bifidum* for all taxa with narrow, forked leaves, regardless of their leaf indumentum or number of carpels. All previously mentioned authors, however, do not seem to have examined the flowers in detail or realised the diagnostic importance of floral characters, as none mentioned carpels or stigma number.

Mueller (1882) transferred all species of *Spyridium*, *Trymalium* Fenzl and *Stenanthemum* into an enlarged *Cryptandra* Sm., since he only accepted the genera *Cryptandra* and *Pomaderris* Labill. in Pomaderreae at that time (Kellermann 2007b). This was reversed by later authors, apart from *Stenanthemum*, the species of which had been subsumed under either *Cryptandra* or *Spyridium* (e.g. Canning 1986) until Rye (1995a) re-instated the genus.

Black (1925) described a distinct entire-leaved form from near Wanilla as *Spyridium bifidum* var. *integrifolium*. This variety is close to *S. bifidum* from Marble Range; it has a trilocular ovary and narrow entire leaves with antrorse simple hairs on the upper surface. Canning (1986) erroneously listed its area of distribution as Kangaroo Island.

During our studies it became apparent that these taxa described in the *Spyridium bifidum* group are well defined and should be recognised. They are restricted to the Marble Range (*S. bifidum* var. *bifidum*), to a range system near Wanilla (*S. bifidum* var. *integrifolium*), and to the eastern Eyre Peninsula, mostly along or near the coast (*Trymalium stenophyllum*). The latter species is transferred by us in this paper to *Spyridium* and the entire-leaved variety of *S. bifidum* is renamed as *S. bifidum* subsp. *wanillae*. However, the majority of specimens from South Australia that have been labelled as '*Spyridium bifidum*' do not match any of the named taxa, since they have the combination of narrow Y-shaped leaves with antrorse hairs and bilocular ovaries. They belong to a taxon that is clearly related to *S. stenophyllum* as both taxa have a 2-carpellate ovary, a condition that is very rare in the tribe Pomaderreae (Kellermann *et al.* 2006); this new taxon is recognised here as *S. stenophyllum* subsp. *renovatum*.

Many entire-leaved specimens from Kangaroo Island that have previously been labelled *S. bifidum*

var. *integrifolium* cannot be placed in any currently recognised species. They are somewhat similar to *S. coalitum* (see below), but differ in having glabrous upper leaf surfaces and very large infructescences. The relationship of these specimens with *S. thymifolium* Reissek, *S. vexilliferum* (Hook.) Reissek and *S. coalitum* is currently under investigation.

The *Spyridium halmaturinum* group

Together with *Trymalium bifidum*, Mueller (1855) described *T. halmaturinum* based on collections from Kangaroo Island and Encounter Bay. He believed that *T. bifidum* was similar to *T. halmaturinum* and might prove to be conspecific. As he did with *T. bifidum*, Reissek (1858) split *T. halmaturinum*, segregating the mainland specimens from Encounter Bay as *Spyridium coactilifolium*. He recognised the segregates in separate genera.

Bentham (1863) accepted both species, but transferred *T. halmaturinum* to *Spyridium*. He also described *S. coactilifolium* var. *integrifolium*, in which he included *S. thymifolium* Reissek and *S. stuartii* Reissek, but this has not been followed by subsequent botanists, who accepted *S. thymifolium* (including *S. stuartii*) as a separate species (e.g. Black 1926, 1952) or subsumed it under *S. parvifolium* (Hook.) F.Muell. (Tate 1890, as *S. hookeri* F.Muell.). *Spyridium thymifolium* is here considered not to be closely related to *S. coactilifolium*.

Mueller (1875) regarded *S. halmaturinum* and possibly *S. coactilifolium* as varieties of *S. bifidum*. Nevertheless, he accepted all three species in the two editions of his *Systematic Census*, albeit under the genus *Cryptandra* (Mueller 1882, 1889).

We demonstrate that *Spyridium halmaturinum* and *S. coactilifolium* are allied through their conspicuous indumentum of large stellate hairs on the upper surface of the leaves. In *S. coactilifolium*, the leaves are very broadly oblong to ovate or orbicular in shape and usually emarginate, and their indumentum consists of very densely and regularly distributed stellate hairs. Leaves in *S. halmaturinum* vary from cuneate to obcordate and are usually deeply emarginate or bilobed; their indumentum varies in density and simple, 2- or 4-fid hairs are present as well.

Tate (1889a, b, c) described a new species on Kangaroo Island, *Cryptandra scabrida*, with characteristics of oblong, emarginate leaves with a moderately dense cover of long antrorse to spreading hairs. Notably, Tate published the species with his collection name '*Spyridium scabridum*' as a synonym. Evidently he had not been sure in which genus to place the taxon. It was subsequently transferred to *S. halmaturinum* as var. *scabridum* by Black (1926). In this paper we recognise it as a separate species in *Spyridium*.

Black (1925) described *Spyridium halmaturinum* var. *integrifolium* from Kangaroo Island specimens with entire leaves that carried a similar indumentum to that on the leaves of *S. halmaturinum*. All other species in the *S. halmaturinum* complex have free stipules. This taxon is here raised to specific rank as *S. coalitum*; it differs from typical *S. halmaturinum* in the presence of fused stipules and leaves that are oblong to narrowly elliptic.

For many years, a taxon conspicuous in its forked leaves and stellate indumentum was known from just south of the Little Desert in western Victoria. It was first collected in 1894 by St. E. D'Alton and since then referred to as *Cryptandra bifida*, *Spyridium bifidum* or *S.* aff. *bifidum* (e.g. Willis 1973). Its distinct status was formally recognised by Walsh (1999), who named it *Spyridium* sp. 1. Although the taxon shares Y-shaped leaves with *S. bifidum* and *S. stenophyllum*, the distinctive stellate hairs, its free stipules and other characters clearly place it into the *S. halmaturinum* group. The species is described formally in this paper as *S. furculentum*.

An isolated atypical population from near Woods Well in the Coorong region of South Australia, has been of continued conservation interest since its discovery in 1973. The taxon was re-collected several times. It has been included in *S. coactilifolium* (e.g. Jessop 1989) or *S. halmaturinum*, species endemic to the Victor Harbor region and Kangaroo Island respectively, but differs from true *S. coactilifolium* in its smaller leaf size and sparse indumentum on the upper surface of the leaves and from *S. halmaturinum* in its leaf shape and infructescence structure. Since, in our opinion, it cannot be subsumed under either species, we recognise a new taxon, *S. fontis-woodii*.

The current view of *S. halmaturinum* has remnant complexity since many populations of taxa within the *S. halmaturinum* group seem to intergrade and hybridisation can frequently be observed with other taxa, such as *S. vexilliferum* (Hook.) Reissek, *S. thymifolium*

or *S. parvifolium* (Hook.) F.Muell., where both parent species occur.

Characters

Characters useful in delimiting species and subspecies of the *Spyridium bifidum* – *S. halmaturinum* complex are summarised in Tables 1 and 2. Usually a combination of these characters is needed to adequately define taxa. Some characters are discussed in more detail below.

Leaf shape. Many authors lumped together taxa with deeply emarginate or Y-shaped leaves. However, three of four taxa in the *S. bifidum* group have cuneate, Y-shaped leaves (the exception being *S. bifidum* subsp. *wanillae*, which agrees in most other characters with *S. bifidum* subsp. *bifidum*) and also one species in the *S. halmaturinum* group (*S. furculentum*). *Spyridium halmaturinum* is very variable in leaf shape and size (see Fig. 4c, and discussion under that species). *Spyridium scabridum* has narrow, emarginate leaves, *S. coactilifolium* and *S. fontis-woodii* have broadly obovate to oblong, emarginate leaves. *Spyridium coalitum* and *S. bifidum* subsp. *wanillae* are the only two taxa with an entire, acute to obtuse leaf apex.

Indumentum. A prime diagnostic feature of the tribe Pomaderreae is stellate hairs (Richardson *et al.* 2000; see also Weberbauer 1895). These are also present on all species of the *S. bifidum* – *S. halmaturinum* complex on most parts of the plants. Features of the indumentum on the upper surface of the leaves are particularly important in defining taxa in the complex, notably the density of the indumentum, the number of arms of stellate hairs, and the presence or absence of simple hairs.

Spyridium halmaturinum and closely related species have stellate hairs with a distinct basal swelling (Fig. 1e; see also Kellermann 2007a), which remains as a tubercle on the leaf surface once the rays of the hairs have fallen off; this basal swelling has not been detected in other species of *Spyridium*. Most species of the *S. halmaturinum* group have a dense (*S. coactilifolium*, *S. halmaturinum*) to sparse (*S. fontis-woodii*, *S. furculentum*) indumentum of stellate hairs on the upper surface of the leaves. *Spyridium scabridum*, while allied to this group by other features, is discordant through having simple hairs on the upper surface that also have a basal swelling.

Taxa in the *S. bifidum* group have simple antrorse hairs on the upper leaf surface and no stellate hairs, with the exception of *S. stenophyllum* subsp. *stenophyllum*, which is glabrous. Density of these simple hairs varies within taxa.

The issue of whether these simple hairs are homologous to stellate hairs still needs to be examined; a paper on hair types in Pomaderreae is in preparation by the first author.

Stipules. The usefulness of stipule characters in delimiting species and genera within Pomaderreae has only come to light recently (Barker 1995; Thiele 2007, expanding the information presented in Thiele & West 2004; Kellermann 2006a). Stipule characters are important in distinguishing taxa within the *S. bifidum* – *S. halmaturinum* complex (Barker 1995). Species of the *S. bifidum* group have stipules that are connate for 1/2 to 2/3 of their length behind the petiole (Fig. 6d, m), whereas *S. halmaturinum* and its relatives *S. coactilifolium* and *S. fontis-woodii* possess free, overlapping stipules. *Spyridium scabridum* has abutting or only slightly overlapping, free stipules. Some species in the complex are very resinous, especially on stipules and bracts. This results in stipules often sticking together and appearing fused, at least in dried specimens. *Spyridium coalitum*, although having many features in common with the *S. halmaturinum* group, has the fused stipules of the *S. bifidum* group.

Inflorescence. Species of *Spyridium* have the flowers arranged in more or less condensed cymes (Thiele 2007), often appearing head-like, with persistent stipule-like bracts subtending the basic flower unit, a dichasium (his Table 1). They are usually subtended by 'floral leaves' that are covered in a dense, white, stellate indumentum and subtend unit-cymes or the whole inflorescence. All but one species in the *S. bifidum* – *S. halmaturinum* complex have head-like inflorescences. The flowers in *S. scabridum* are arranged in more loose cymes, a situation that also occurs in other species of the genus, e.g. *S. daltonii* and *S. globulosum* (Labill.) Benth. (Kellermann 2006b). Both subspecies of *S. bifidum* have very conspicuous, larger flower heads, when compared to *S. stenophyllum*, reflecting a larger number of flowers in each head. Floral leaves are present in all species of the complex.

As it matures, the head-like inflorescence of several species expands, presumably to accommodate the enlarging ovary in developing fruits and to aid the release of the fruits. The bracts of these expanding heads appear in a conspicuous 'tiled' pattern (Fig. 1q). Infructescences of this type are found in *S. coactilifolium*, *S. fontis-woodii*, *S. furculentum*, *S. scabridum* and *S. coalitum* of the *S. halmaturinum* group. They have also been observed in other species of the genus, for example *S. thymifolium*. The distribution of this character throughout the genus requires closer examination of fruiting specimens (which are unfortunately rarely present in herbarium collections) or the observation of plants in the field. In contrast, the infructescences of the remaining species of the complex hardly expand and remain a more or less compact head, without displaying the tiled bract pattern.

Flowers. The species in this complex display the typical *Spyridium* flower. Indumentum of sepals, hypanthium tube and flower base is used diagnostically. The relative length of limb and claw of the tiny petals has also proved useful in distinguishing groups of species. For example, *S. halmaturinum*, *S. fontis-woodii*, *S. furculentum* and *S. coactilifolium* all have a very short claw relative to the petal length, the limb up to eight times longer than the claw. The claw in the remaining species is longer, the limb only up to twice as long as the claw.

The number of stigma lobes (equalling the number of carpels) is useful in identifying *S. stenophyllum*, as bifid stigmas and bilocular ovaries are very unusual in the genus and the tribe Pomaderreae (see discussion under that species). The usual numbers of carpels and stigmatic lobes in *Spyridium* is three.

Fruits. Generally, fruits in *Spyridium* have the same number of fruitlets as carpels and stigmatic lobes (Thiele

Table 1. Characters distinguishing taxa in the *Spyridium bifidum* group. *Spyridium coalitum* is intermediate and also shares characters with the *S. halmaturinum* group (see Tab. 2).

	S. stenophyllum* subsp. *renovatum	***S. stenophyllum* subsp. *stenophyllum***	***S. bifidum* subsp. *bifidum***	***S. bifidum* subsp. *wanillae***	***S. coalitum***
Plant resinous	yes	yes	no	no	yes
Leaf shape	narrowly Y-shaped, cuneate	narrowly Y-shaped, cuneate	Y-shaped, cuneate, obcordate	narrow oblong, oblanceolate, linear	oblong, narrow elliptic
Leaf apex	shallow to deeply emarginate or bilobed	shallow to deeply emarginate to bilobed (rarely almost entire)	deeply emarginate	entire, obtuse to apiculate	entire, obtuse
Leaf margin	revolute	revolute	revolute	revolute	revolute
Stipule fusion	fused > 1/2	fused 1/2 – 2/3	fused >1/2 (most > 3/4)	fused 1/2 – 3/4	fused
Leaf upper surface indumentum density	medium to dense	glabrous	sparse to medium	dense	sparse to dense, glabrescent
Leaf upper surface hair type	simple, antrorse, long	n/a	simple, antrorse, long	simple, appressed, antrorse, long	stellate, some simple hairs, or both types mixed
Basal swelling on hairs	absent	n/a	absent	absent	present
Branchlet indumentum colour	light brown	white to grey	white to grey	off-white	light to rust brown
Inflorescence diameter	0.6–1.1	0.6–0.8	0.9–1.2	0.8–2	0.5–1.3
Infructescence bracts tiling	absent	absent	absent	absent	present
Petal limb:claw ratio (approx.)	3 : 1	4–5 : 1	2 : 1	5 : 2	2 : 1
Stigma	2-fid	2-fid	3-fid (some appear entire)	3-fid	3-fid
Fruits	pubescent	pubescent	pubescent	pubescent	glabrous

2007) or less (by lack of development after anthesis). There are two distinct types of fruits found in the *S. bifidum* – *S. halmaturinum* complex, which separate the two groups. Fruits of the *S. halmaturinum* group are dark brown or black and either more or less glabrous or with a few simple hairs, especially at the base (Fig. 1h). The *S. bifidum* group has light brown, densely hairy fruits (Fig. 6e).

Black (1926, 1952; and in notes on sheets of his personal herbarium at AD) already observed differences but diverged in his interpretation. He described fruits of *S. coactilifolium* and *S. halmaturinum* as 'brown, crustaceous, [...] glabrous' and 'black, hard, almost glabrous', respectively; and fruits of *S. bifidum* as 'densely silky or villous'. Our observations cannot confirm these differences in texture: fruitlets in all taxa are membranous or papery and white to semi-translucent ('hyaline' in Black's words).

Affinities of the complex

It is difficult to discuss affinities of the members of this complex and other taxa within *Spyridium* in advance of a revision and a more densely sampled phylogenetic analysis (cf. Kellermann *et al.* 2005, Kellermann & Udovicic 2008), particularly as infrageneric groups within the genus are not readily recognisable. However, features restricted to some species, such as different foliar hair types (stellate hairs or antrorse hairs with one to few arms), emarginate to Y-shaped leaves, degree of fusion of stipules, the extent of indumentum on the ovary and fruit, and carpel number, enable some discussion of possible relationships of members of the complex.

The *Spyridium bifidum* group is characterised by: fused stipules; fruits covered in (mainly) long simple hairs with a light brown fruit wall; a light-coloured indumentum

Table 2. Characters distinguishing taxa in the *Spyridium halmaturinum* group.

	S. scabridum	*S. halmaturinum*	*S. fontis-woodii*	*S. furculentum*	*S. coactilifolium*
Plant resinous	yes	yes	no	no	no
Leaf shape	narrowly obovate, narrowly oblong	obovate, obcordate, cuneate, Y-shaped	obovate, obcordate, some cuneate	Y-shaped, rarely obovate	round, broadly oblong
Leaf apex	slightly emarginate	shallow to deeply emarginate, often tridentate	shallow to deeply emarginate, rarely tridentate	deeply emarginate; Y-shaped	entire to slightly emarginate, sometimes tridentate
Leaf margin	revolute	revolute	recurved to revolute	revolute	flat to slightly recurved
Stipule fusion	free, abutting or overlapping	free, overlapping	free, overlapping	free, overlapping	free, overlapping
Leaf upper surface indumentum density	medium	medium dense, glabrescent	sparse to medium dense, glabrescent	sparse, glabrescent	sparse to moderately dense
Leaf upper surface hair type	simple: long on younger leaves, shorter and scabrous on older	stellate, rarely also bifid or simple	stellate or bifid, often only simple, sometimes glabrescent	stellate (often only 2–3 arms); subantrorse; hair arms, long, weak	stellate (6–8 arms)
Basal swelling on hairs	present	present	present	present	present
Branchlet indumentum colour	light brown	light brown	rust brown	rust brown	rust brown
Inflorescence diameter	0.5–1.2	0.7–1.1	0.8–1.3	0.6–1.0	0.6–1.7
Infructescence bracts tiling	present	absent	present	present	present
Petal limb:claw ratio (approx.)	4 : 1	8 : 1	8 : 1	8 : 1	8 : 1
Stigma	3-fid	3-fid	3-fid	3-fid	3-fid
Fruits	glabrous	glabrous	glabrous	glabrous	glabrous

on young branches; narrow leaves, which are Y-shaped and bear long simple antrorse hairs in most taxa; and the petal limb approximately twice as long as the claw.

Fused stipules occur in only a few species of *Spyridium* and these are potentially related to taxa of the *S. bifidum* group: *S. oligocephalum* (Turcz.) Benth. and *S. polycephalum* (Turcz.) Benth. from W.A.; *S. waterhousei* from Kangaroo Island; Eyre Peninsula endemics *S. erymnocladum* and *S. leucopogon* (F.Muell. ex Reissek) F.Muell.; the more widespread *S. phylicoides* Reissek, *S. subochreatum* (F.Muell.) Reissek and *S. eriocephalum* Fenzl. Of these, *S. erymnocladum* and *S. leucopogon* also have fruits covered with simple hairs and are geographically close. *Spyridium leucopogon* somewhat resembles *S. bifidum* subsp. *wanillae*, but is a smaller shrub with smaller flower heads and shorter, glabrous leaves. Leaves of both *S. leucopogon* and *S. stenophyllum* subsp. *stenophyllum* are glabrous and have a recurved mucronate apex, but are much longer and Y-shaped in *S. stenophyllum*. The relationship of all species with fused stipules and the usefulness of this character within the genus is currently under investigation.

The *S. halmaturinum* group is defined as having: free, overlapping stipules; almost glabrous, brown to black fruits; a more or less rusty brown indumentum on young shoots; leaves in a variety of shapes, but generally broader and bearing an indumentum of stellate hairs in most taxa; hairs with a distinct swollen base that remains on the leaf as a tubercle (if the hair arms are deciduous); and in some species a petal limb up to eight times longer than the claw.

Some species of *Spyridium* carry an indumentum of stellate hairs on the upper surface of the leaves (*e.g. S. cinereum* N.A.Wakef. from Victoria and N.S.W, typical forms of *S. majoranifolium* (Fenzl) Rye from W.A., or the widespread *S. subochreatum*), but these are in most instances small, dense stellate hairs, unlike the larger stellate hairs with swollen bases, as seen in *S. halmaturinum* and related species. Occasionally, densely hairy upper leaf surfaces are also seen in plants of species that generally have glabrous or sparsely hairy leaves, such as the widespread south-eastern Australian *S. parvifolium* or *S. globulosum* from W.A. *Spyridium polycephalum* from W.A. has more similar, larger stellate hairs that sit on a tubercle, similar to the swollen bases of *S. halmaturinum*, but the species differs in the presence of fused stipules (see above).

Methods

Descriptions were compiled from herbarium specimen from the following herbaria: AD, BM, CANB, K, MEL, NSW. Taxa were also observed in the field. Measurements of flower parts are made from rehydrated material. The indumentum of the leaves of some species was examined with SEM, but more detailed results will be published elsewhere.

Flower terminology in this and other papers (Kellermann 2006a, b, c) differs from that of Rye (1995a, b, 1996, 2008) and Barker (Barker 1995; Barker & Rye 1993) in the following points: *hypanthium tube* is used for Rye's *free tube* and Barker's *flower tube*, and *(hypanthium) base* instead of Rye's *adnate tube* and Barker's *ovary*.

To avoid future confusion, we have chosen not to retain the varietal epithet *'integrifolium'* attributed to three unrelated taxa in this complex when raising these varieties to subspecies or species level.

Identification slips with superseded manuscript names were placed on returned loans and during herbarium visits to MEL and CANB a few years ago. These affect *S. furculentum*, *S. fontis-woodii* and *S. bifidum* subsp. *renovatum*. The replaced names are not presented here to avoid unnecessary publication of *nomina nuda*.

For conservation reasons exact locality information was removed for taxa listed as 'Rare' and 'Vulnerable' (NPWC 2003; Walsh & Stajsic 2007).

Taxonomy

1. *Spyridium coactilifolium* Reissek, *Linnaea* 29: 291 (1858).

Benth., *Fl. Austral.* 1: 431 (1863); M.R.Schomb., *Fl. S Australia* 37 (1875); F.Muell., *Fragm.* 9: 136 (1875); Tate, *Trans. & Proc. Rep. Roy Soc. South Australia* 3: 66 (1880); J.M.Black, *Fl. S. Austral.* 3: 368 (1926); ed. 2, 3: 549 (1952); H.Eichler, *Fl. S. Austral. Suppl.* 218 (1965); E.M.Canning in Jessop & Toelken, *Suppl. J.M.Black's Fl. S. Austral.* 2: 815 (1986); R.J.-P.Davies, *Threatened Pl. Species Mt Lofty Ra. & Kangaroo Is. Region* 74–76 (1986); W.R.Barker, *J. Adelaide Bot. Gard. Suppl.* 1: 90 (2005). — *Cryptandra coactilifolia* (Reissek) F.Muell., *Syst. Census Austral. Pl.* 61 (1882). F.Muell., *Second Syst. Census Austral. Pl.* 104 (1889); Tate, *Trans. & Proc. Rep. Roy. Soc. South Australia* 12: 94 (1889); *Handb. Fl. Extratrop. S. Australia* 97 (1890). — *Pomaderris*

coactilifolia F.Muell. ex Reissek, *Linnaea* 29: 291 (1858), *nom. inval. pro syn.* — *Type citation*: 'Encounter Bay (Dr. F. Müller)'. *Lectotype (here designated)*: Encounter Bay, *s.dat., s.coll.* (MEL 233432, ex Herb. Reissek). *Isolectotypes*: MEL 233435; K (ex Herb. Hookerianum, top three branchlets on sheet with loan stamp and number: H/1310/95 15/76).

Spyridium bifidum auct. non (F.Muell.) F.Muell. ex Benth.: F.Muell., *Fragm.* 9: 136 (1875), *pro parte.*

Illustrations: E.M. Canning in J.P. Jessop & H.R. Toelken, *Flora of South Australia* 2: 816, fig. 429B (1986); R.J.-P. Davies, *Threatened plant species of the Mount Lofty Ranges and Kangaroo Island regions of South Australia* 74 (1986); A. Prescott, *It's blue with five petals: wildflowers of the Adelaide region* 143, fig. 6 & 145, fig. 3 (1988); G.R.M. Dashorst & J.P. Jessop, *Plants of the Adelaide Plains & Hills*, ed. 3, 101, pl. 43.6 (1990).

Spreading, usually rounded *shrubs* 0.3–1.8 m high, not resinous; young stems densely pubescent with stellate and long simple hairs, first rusty to dark brown, later becoming greyish. *Leaves* alternate: *stipules* free, 1.5–2.5 mm long, reddish brown, overlapping behind

Key to species and subspecies of the *Spyridium bifidum – S. halmaturinum* complex

1. Leaves distinctly Y-shaped ('bifid leaves'), the basal part of the blade narrower than the spread of the lobes 2
1: Leaves entire, shortly lobed or emarginate, the basal part of the blade broader or as broad as the distal lobes when present 5

2. Upper surface of leaves with stellate hairs; stipules free; fruits almost glabrous; Victoria ..... **3. *S. furculentum***
2: Upper surface of leaves with simple hairs or glabrous; stipules fused; fruits densely hairy; South Australia 3

3. Style 2-fid; ovary 2-locular (rarely some 3-locular flowers with 3-fid stigmas present); leaves 1.2–2.8 mm wide; inflorescences 8–11 (–12) mm in diameter 4
3: Style 3-fid; ovary 3-locular; leaves 1.9–5 mm wide; inflorescences 10–12 mm diameter ..... **7a. *S. bifidum* subsp. *bifidum***

4. Upper surface of leaves glabrous; leaf-lobes mucronulate, with a recurved apex .. **8a. *S. stenophyllum* subsp. *stenophyllum***
4: Upper leaf surface with simple, antrorse hairs; leaf-lobes with a ± obtuse apex hidden by a tuft of hairs ..... **8b. *S. stenophyllum* subsp. *renovotum***

5. Leaves narrowly oblong to narrowly elliptic or narrowly obovate 6
5: Leaves broad, obovate to obcordate or cuneate or elliptic to oblong 8

6. Upper surface of leaves with stellate hairs, rarely some simple hairs ..... **6. *S. coalitum***
6: Upper surface of leaves with simple hairs only 7

7. Leaves narrowly oblong with an acute, sometimes recurved mucro; stipules fused; hairs on upper leaf surface short, ± appressed, antrorse; inflorescence a compact globular head of sessile flowers ..... **7b. *S. bifidum* subsp. *wanillae***
7: Leaves narrowly obovate to narrowly oblong, apex emarginate with a recurved tip, but not mucronate; stipules free or abutting; hairs on upper surface long, antrorse to spreading; inflorescence elongated, a loosely arranged cyme with sessile flowers ..... **5. *S. scobridum***

8. Leaves round to elliptic or broadly oblong; margin ± flat; indumentum on upper surface dense, consisting of evenly spaced stellate hairs (with usually 8 or more arms) ..... **1. *S. cooctilifolium***
8: Leaves obovate to obcordate, cuneate; margin recurved to strongly revolute; indumentum on upper surface sparse to medium dense, sometimes glabrescent, consisting of stellate hairs, bifid and simple hairs 9

9. Leaves cuneate, obovate to obcordate, rarely Y-shaped, (2.7–) 5.5–10 mm long; indumentum on upper leaf surface of mostly stellate hairs ..... **4. *S. holmaturinum***
9: Leaf broadly obovate, 4–8.8 mm long; indumentum on upper leaf surface of some stellate (with up to 6 arms), but mostly bifid and simple hairs ..... **2. *S. fontis-woodii***

Fig. 1. a–h, *Spyridium coactilifolium*: a, habit; b, upper surface of leaf; c, lower surface of leaf; d, upper surface of floral leaf; e, cross-section of leaf with stellate hairs; f, stipules; g, part of flower; h, fruit. **i–l, *S. fontis-woodii*:** i, habit; j, upper surface of leaf; k, lower surface of leaf; l, stipules. **m–q, *S. furculentum*:** m, habit; n, upper surface of leaf; o, lower surface of leaf; p, stipules; q, fruiting flower head from below, showing tiled bracts. a–e, h: *W.R. Barker 7612* (AD 173245); f, g: *J. Kellermann 438 & H.R. Toelken*; i–k: *J. Kellermann 441 et al.*; l, *W.R. Barker 7611 et al.*; m, *J.A. Jeanes 1499 et al.*; *1499*; n–q, *W.R.Barker 7606 et al.* (AD 225116); q, *W.R. Barker 7606 et al.* (AD 173231). **Scale bar:** a, 17.2 mm; b, c, 5.2 mm; e, 4.2 mm; f, 3 mm; g, 1.25 mm; h, 1.6 mm; i, 17.3 mm; j, k, 5 mml; l, 2.8 mm; m, 18mm; n, o, 5.25 mm; p, 2.5 mm; q, 6 mm

petiole, glabrous on both sides, with a few cilia and apical hairs; *petiole* 1–2 (–2.5) mm long, densely stellate pubescent; *lamina* broadly ovate to broadly obovate, orbicular or very broadly oblong, (5–) 8–20 mm long, (4–) 5.5–10 (–14) mm wide, base obtuse or truncate, margins ± flat, apex entire to emarginate, sometimes tridentate, upper surface green, covered with a sparse to moderately dense white to greyish indumentum of stalked stellate hairs, lower surface of a paler colour due to a denser cover of stalked stellate hairs, the hairs on midrib and margins rusty, especially when young. *Floral leaves* usually 4 or 5, smaller than stem leaves: (3.6–) 6–12 mm long, 2.4–9 mm wide, covered with a very dense, white velvety stellate indumentum. *Inflorescence* a dense head of cymosely arranged ± sessile flowers, 6–17 mm diameter; *bracts* broadly ovate, 1.8–2.2 mm long, 1.5–2 mm wide, margins long-ciliate, sometimes denticulate. *Flowers* white. *Hypanthium tube* 0.6–0.7 mm long, c. 1.5 mm diameter, moderately to densely pubescent with long hairs, becoming sparse when old; base with long hairs. *Sepals* 0.6–0.7 mm long, as long as hypanthium tube, moderately to densely covered with long stellate or simple hairs; sepal:tube ratio 1:1. *Petals* 0.3–0.5 mm long, cucullate, very shortly clawed; limb:claw ratio c. 8:1. *Stamens* subequal to the petals, 0.25–0.5 mm long; *anthers* 0.2 mm long. *Ovary* inferior, carpels 3, summit covered with stellate hairs with long erect arms; *style* 0.7–0.9 mm long, minutely 3-lobed. *Infructescence* expanding as it matures; bracts in layers, appearing tiled. *Fruits* ellipsoid to obovoid, 1.9–2.3 mm long, 1.5–1.6 mm wide, dark brown, consisting of 3 papery fruitlets, torus apical, externally glabrous or with a few hairs; *seeds* flattened obovoid, c.1.5 mm long, 0.9–1 mm wide, brown with a few dark spots and a darkened base; aril small, easily detached. Fig. 1a–h. Fig. 3a.

***English name*:** Butterfly spyridium (Canning 1986).

***Distribution & habitat*:** The species occurs in coastal scrub- and heathlands and open woodlands, on limestone hills, exposed cliffs, sandy ridges and dunes. It is endemic to the coast and hinterland between Victor Harbor (known earlier as Port Victor and Encounter Bay), west to Parsons Beach, Fleurieu Peninsula, S.A. (Fig. 2). An old Mount Lofty locality (*S.A. White s.n.*, AD 96803467) is surely erroneous.

***Phenology*:** Flowering nearly all year round, flowers being recorded in Jan.–Apr., July–Oct., Dec. Fruiting specimens have been collected in Aug.–Oct.

***Affinities*:** The species is very closely related to

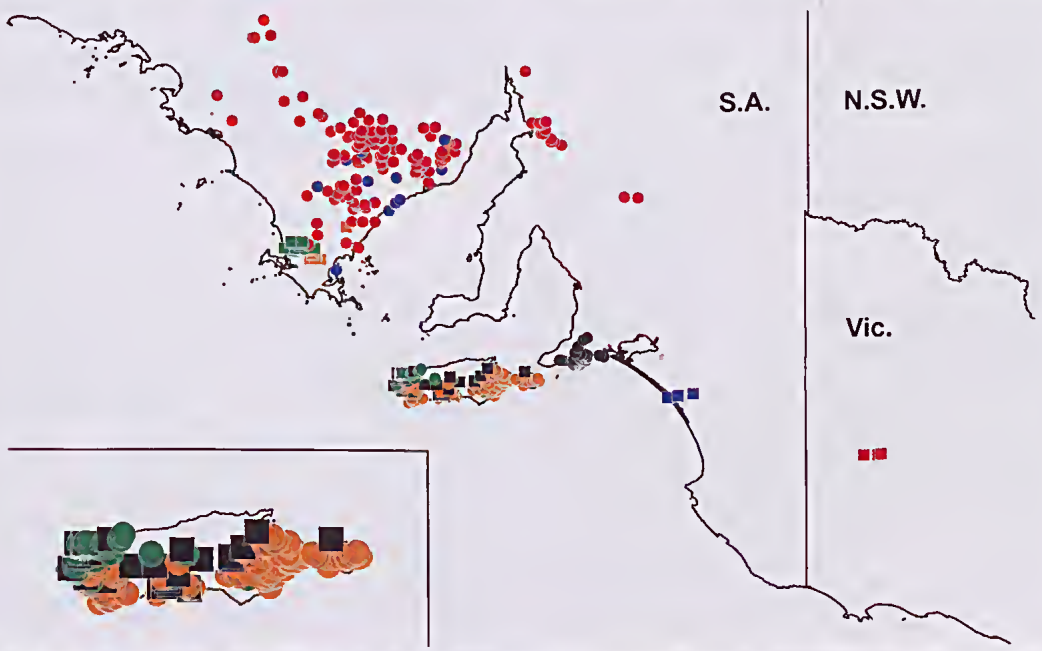

Fig. 2. Distribution map. (Kangaroo Island shown enlarged in inset.) ***Spyridium halmaturinum* group:** *S. cooctilifolium*, black circles; *S. fontis-woodii*, blue squares; *S. furculentum*, red squares; *S. halmaturinum*, orange circles; *S. scobridum*, black squares; *S. coolitum*, green circles. ***Spyridium bifidum* group:** *S. bifidum* subsp. *bifidum*, green squares; *S. bifidum* subsp. *wonilloe*, orange squares; *S. stenophyllum* subsp. *stenophyllum*, blue circles; *S. stenophyllum* subsp. *renovatum*, red circles.

Fig 3. a, *Spyridium coactilifolium*: flowering branch. **b, c, *S. fontis-woodii*:** b, flowering branch; c, inflorescence surrounded by floral leaves. **d, e, *S. furculentum*:** d, flowering branch with old infructescence, seeds shed (lower left); e, inflorescence (note unusual 4-merous flower). a, *W.R. Barker 7612* (AD 173245); b, c, *W.R. Barker 7611 et al.*; d, e, *W.R. Barker 7606 et al.* Photos by W.R. Barker.

S. halmaturinum from Kangaroo Island, *S. fontis-woodii* from the Coorong region and *S. furculentum* from the Little Desert, Vic. All four species share the presence of conspicuous large stalked stellate hairs on the upper surface of the leaves and large, free stipules.

***Notes*:** One unusual specimen (*R. Taylor 234*, AD 99751099) does not have dense flower-heads, but more open cymose inflorescences and smaller leaves; these still carry the characteristic stellate indumentum. This is possibly a hybrid with *S. parvifolium*.

***Typification*:** Reissek lived and worked at the Naturhistorisches Museum in Vienna (W); however, no specimens of the species could be found at that institution (E. Vitek, pers. comm., Jan. 2008). There are two specimens collected at Encounter Bay at MEL, one of which is labelled by Mueller as "Spyridium (Trym?) coactilifolium Ferd. M. / Encounter Bay", and by Reissek and Bentham as *S. coactilifolium*. This specimen is from Reissek's own herbarium and is designated here as lectotype. The sheet carries a recent annotation by unknown hand that it was probably collected by Charles Stuart, who collected at Encounter Bay in November 1847, before Mueller arrived in Australia. However, the basis of this claim could not be established. It is as likely that Mueller visited Encounter Bay when he lived in South Australia (1847–1851). The second MEL specimen, as well as a duplicate at K, are isolectotypes.

***Conservation*:** The species has a narrow distributional range and is listed as 'Vulnerable' in S.A. and nationally (Willson & Bignall 2008).

***Etymology*:** The epithet is composed of the Latin *coactilis*, made thick, felted (Georges 1913), and *folium*, leaf, on account of the densely stellate indumentum on the upper surface of the leaves.

***Selected specimens examined* (c. 100 seen): SOUTH AUSTRALIA.** SOUTHERN LOFTY: [Precise locality information withheld for conservation reasons] W of Victor Harbor, 25 Sep. 1972, *C.R. Alcock 3974* (AD, MEL); Parsons Beach entry road, 29 Oct. 1995, *W.R. Barker 7613 & R.M. Barker* (AD, MEL); Port Victor, 12 Feb. 1894, *R. Brummitt s.n.* (AD); Waitpinga Beach, 3 Dec. 1985, *N.N. Donner 11208* (AD, AK, BR, BRI, CAS, H, I, LSU, PE, PTBG, TCD); Newland Head, 28 May 1986, *N.N. Donner 11273* (AD, JBVN, MA, MEL, PRE); Parsons Beach, 22 Oct. 2006, *J. Kellermann 438 & H.R. Toelken* (AD); Newland Head C.P., 8 Dec. 2008, *R. Taylor 1133* (AD); Fleurieu Peninsula, Victor Harbor–Waitpinga road, 12 Oct. 1995, *F. Udovicic 322* (AD, CANB, MEL, PERTH); Newland Hill, 23 Nov. 1983, *D.J.E. Whibley 8969* (AD, CANB, DAO, RSA, UTEP); Newlands Head, 1 Oct. 1985, *D.J.E. Whibley 9996* (AD, GZU, HO, STU); Newlands Head, 2 Oct. 1985, *D.J.E. Whibley 10053* (AD, MEL).

2. *Spyridium fontis-woodii* Kellermann & W.R.Barker, *sp. nov.*

A Spyridio coactilifolio *Reissek foliis minoribus indumento superficiali grossiore ex pilis simplicibus bifidisque vel raro stellatis (plerumque 3–6 radiatis) constanti differt.*

Holotypus: **SOUTH AUSTRALIA.** [Precise locality information withheld for conservation reasons] Road near Woods Well, 22. Oct. 1995, *W.R. Barker 7611, R.M. Barker & E. Kuzmanov* (AD 173247). *Isotypi:* B, BRI, CAN8, MEL, NSW, NY, PERTH, SI.

Spyridium halmaturinum var. *halmaturinum auct. non* (F.Muell.) F.Muell. ex Benth.: E.M.Canning in Jessop & Toelken, *Fl. S. Austral.* 2: 817 (1986), *pro parte*; W.R.Barker, *J. Adelaide Bot. Gard. Suppl.* 1: 90 (2005), *pro parte*.

Spyridium coactilifolium auct. non Reissek: W.R.Barker in Jessop, *List Vasc. Pl. S. Austral.*, ed. 4, 55 (1993), *pro parte*.

Slender *shrubs* to 1.8 m high, not resinous; young stems densely pubescent with stellate and long simple hairs, first rusty, later becoming greyish. *Leaves* alternate: *stipules* ovate, 1.6–2.6 mm long, free, brown, overlapping behind petiole, glabrous on both sides, apart from a few hairs along midrib and sometimes a few cilia or apical hairs; *petiole* 1–2 mm long, densely stellate pubescent; *lamina* broadly obovate to obcordate or very broadly oblong, 4–8.8 mm long, 3.5–6.5 mm wide, base obtuse, margins recurved to revolute, apex emarginate, rarely tridentate, upper surface green, sparsely to moderately covered with a white to greyish hispid indumentum of simple and bifid hairs, sometimes stellate hairs, becoming glabrous with age, lower surface of a paler colour due to a denser cover of stalked stellate hairs. *Floral leaves* usually 4 or 5: 3.5–5 mm long, 3–4.3 mm wide, covered with a very dense, white velvety stellate indumentum. *Inflorescence* a dense head of cymosely arranged ± sessile flowers, 8–13 mm diameter; *bracts* broadly ovate to orbicular, 1.3–1.5 mm long, with long cilia and long hairs outside on lower half, margin sometimes deticulate. *Flowers* white to cream. *Hypanthium tube* 0.2–0.5 mm long, 1.2–1.5 mm diameter, densely pubescent with long

hairs, becoming more sparsely so when old, base with denser long hairs. *Sepals* 0.7–0.8 mm long, longer than hypanthium tube, densely covered with long stellate or simple hairs; sepal:tube ratio 2–3:1. *Petals* 0.3–0.4 mm long, cucullate, very shortly clawed, cream to yellow; limb:claw ratio *c.* 8:1. *Stamens* subequal to the petals, *c.* 0.4 mm long; *anthers c.* 0.2 mm long. *Ovary* inferior, carpels 3, summit covered with long erect stellate hairs; *style* 0.5–0.7 mm long, minutely 3-lobed. *Infructescence* expanding as it matures; bracts in layers, appearing tiled. *Fruits* ellipsoid to obovoid, 2–2.2 mm long, 1.2–1.8 mm wide, dark brown, consisting of 3 papery fruitlets, torus apical, externally glabrous or with a few hairs; *seeds* flattened obovoid, 1.2–1.5 mm long, 0.8–0.9 mm wide, light brown or brown with a few dark spots and a darkened base; aril small, easily detached. Fig. 1i–l, Fig. 3b–c.

***Distribution & habitat*:** The species occurs in *Eucalyptus diversifolia* Bonpl. open shrubland, on light brown sand, usually over partially exposed limestone. It is restricted to an area near Woods Well, S.A. (Fig. 2).

***Phenology*:** Flowering and fruiting material has been collected in Oct.

***Affinities*:** The species shares with *S. furculentum* the less stellate indumentum on the upper side of the leaves. It is close to *S. halmaturinum* and *S. furculentum* in its coarser type of stellate hairs which are not as evenly distributed. The leaf shape, however, resembles that of *S. coactilifolium*, but leaves in *S. fontis-woodii* are much smaller.

***Conservation*:** Location details indicate that the species is likely to be confined to one population, despite its taxonomic and conservation significance being known for over 30 years. It occurs in an unreserved area of paddocks and roadside, which has been extensively cleared and is under threat from crop and invasive plants, and road use and maintainance. The population is estimated to number well over 20 plants, but is unlikely to be more than 50 plants (*W.R. Barker 7611 et al.*). As a result it is recommended that it should be treated as 'Critically Endangered' under the IUCN criteria used in State conservation assessments (NPWC 2003).

***Etymology*:** The specific epithet, a substantive in genetive form, is derived from the name of the neighbouring locality Woods Well, which was named by Thomas Burr, Deputy Surveyor-General of South Australia, on 18. June 1844 after a 'Mr Wood' (Geographical Names Unit 2000-). The Latin *fons* means well or spring.

***Specimens examined*: SOUTH AUSTRALIA.** SOUTH EAST: [Precise locality information withheld] W of Woods Well, 19 May 1973, *M. Crisp 472* (AD); Road near Woodwell [Woods Well], 22 Sep. 1973, *L. Haegi 540* (AD); Road near Woods Well, N side of road, 15 Dec. 2007, *J. Kellermonn 441 et ol.* (AD); Road near Woods Well, N side, roadside cutting, 30 Jan. 2006, *H.P. Vonow 2875, D.J. Duvol & M.K. Jones* (AD); Road near Woods Well, 7 Nov. 1983, *C.E. Woolcock 1323* (AD); Road near Woods Well, 15 Oct. 1984, *C.E. & D.T. Woolcock s.n.* (MEL).

3. *Spyridium furculentum* W.R.Barker & Kellermann, *sp. nov.*

A Spyridio halmaturino *(F.Muell.) F.Muell. ex Benth. foliis bifidis profunde emarginatis, indumento superficiali sparso et vertice ovario dense pubescente diagnoscenda.*

Holotypus: **VICTORIA.** [Precise locality information withheld for conservation reasons] Cooack Settlement Rd, S of Little Desert N.P. boundary, 21 Oct. 1995, *W.R. Barker 7606, R.M. Barker & E. Kuzmanov* (AD 173231). *Isotypi:* AD, B, BM, CANB, K, MEL, MO, NSW, NY, PERTH, SI, W.

Spyridium sp. nov. (Little Desert) *sensu* J.H.Ross, *Census Vasc. Pl. Victoria*, ed. S, 103 (1996) — *Spyridium* sp. 1 *sensu* N.G.Walsh in N.G.Walsh & Entwisle, *Fl. Victoria* 4: 119 (1999). J.H.Ross, *Census Vasc. Pl. Victoria*, ed. 6, 107 (2000); N.G.Walsh & Stajsic, *Census Vasc. Pl. Victoria*, ed. 8, 120 (2007). — *Spyridium* sp. (Little Desert) (SPRAT database). — *Spyridium* sp. *Little Desert (N.G.Walsh 4767)* (Austral. Pl. Census database).

Cryptandra bifida auct. non F.Muell.: St.E.D'Alton, *Vict. Naturalist* 30: 68, 75 (1913), *pro parte.*

Spyridium bifidum auct. non. (F.Muell.) Benth.: J.H.Willis, *Handb. Pl. Victoria* 2: 370 (1973), *pro parte*; N.G.Walsh in S.J.Forbes *et al.*, *Census Vasc. Pl. Victoria* 7S (1984), *pro parte*; J.H.Ross, *Census Vasc. Pl. Victoria*, ed. 4, 96 (1993), *pro parte.*

Illustrations: N.G. Walsh in N.G. Walsh & T.J. Entwisle, *Flora of Victoria* 4: 118, fig. 20h (1999); M.G. Corrick & B.A. Fuhrer, *Wildflowers of Victoria and adjoining areas* 200, fig. 700 (2000), photo.

Shrub to *c.* 1.6 m high, not resinous; young branchlets densely pubescent with stellate (and possibly long

simple) hairs, first rusty, later becoming greyish. *Leaves* alternate: *stipules* broadly ovate, 1.3–2.8 mm long, free, reddish-brown, overlapping behind petiole, glabrous outside or with few hairs along midrib, margin moderately ciliate; *petiole* 0.9–1.5 mm long, sparsely stellate-hairy, soon becoming glabrous; *lamina* Y-shaped, rarely cuneate with an apical notch, 6–11 mm long, (1.7–) 3.3–7.5 (–8) mm wide, base obtuse, margin revolute, deeply bilobed or emarginate, lobes mostly half as long as undivided part of leaf, upper surface initially with scattered 2- or 3-armed or stellate hairs, arms spreading or slightly antrorse, usually becoming glabrous, but tuberculate (from bases of fallen hairs) at least towards the apex and along the margin, lower surface sparsely to moderately pubescent with stalked stellate hairs. *Floral leaves* 2–5: obcordate, cuneate or Y-shaped, 3.3–5.5 (–8) mm long, (2–) 3–4.5 (–5) mm wide, densely white stellate-pubescent on upper surface. *Inflorescence* a terminal hemispherical head of cymosely arranged sessile flowers 0.6–10 mm diameter; *bracts* broadly ovate 2–2.3 mm long, mostly glabrous, long-ciliate, sometimes with hairs on midrib. *Flowers* white to cream. *Hypanthium tube* 0.4–0.5 mm long, 0.7–1 mm diameter, moderately pubescent with long hairs, base with long hairs. *Sepals* 0.6–0.8 (–0.9) mm long, slightly longer than hypanthium tube, densely white pubescent, especially towards apex; sepal:tube ratio 3:2. *Petals* 0.3–0.5 mm long, cucullate, shortly clawed; limb:claw ratio 5–8:1. *Stamens* subequal to the petals, 0.4–0.5 mm long; *anthers* c. 0.2 mm long. *Ovary* inferior, carpels 3, summit densely pubescent with erect stellate hairs; *style* 0.6–0.8 mm long, entire; stigma minutely 3-lobed. *Infructescence* somewhat expanding as it matures so the bracts are appearing tiled and in layers. *Fruit* ovoid, (1.8–) 2–2.5 mm long, 1.4–1.6 mm wide, dark brown, consisting of 3 papery fruitlets, torus in upper 1/3 or apical, externally glabrous or with a few hairs; *seeds* flattened ellipsoid, c. 1.9 mm long, 1–1.1 mm wide, light brown with black mottles and a darkened brown base; aril small, easily detached. Fig. 1m–q, Fig. 3d–e.

***English name*:** Forked spyridium (D'Alton 1913; Walsh 1999).

***Distribution & habitat*:** The new species is endemic to a small area near the southern boundary of the Little Desert between Goroke and Dimboola. It grows in mallee woodland dominated by *Eucalyptus arenacea* Marginson & Ladiges and *Callitris rhomboidea* R.Br. ex Rich. & A.Rich. with a diverse sclerophyllous shrub understorey on (deep) brown-white sand. (Fig. 2).

***Phenology*:** Flowers recorded Feb., May, Aug.–Nov.; Fruiting: Aug–Nov.

***Affinities*:** The species is closely related to *S. halmaturinum* and *S. fontis-woodii*, with which it shares a similar indumentum on the upper surface of the leaves, free stipules and glabrous fruit, but both species are more pubescent plants with relatively broader, shallowly emarginate leaves. *S. furculentum* differs in its deeply emarginate, bifid or Y-shaped leaves, and the fact that the upper leaf surface soon becomes glabrous. It is not closely allied to *S. bifidum* as has been indicated in the past (D'Alton 1913; Willis 1973); that taxon is endemic to Eyre Peninsula and differs in having generally narrower, less deeply bifid leaves that are silky-pubescent to almost glabrous above, fused stipules, and densely hairy fruits.

***Notes*:** St. Eloy D'Alton was the first to collect the species in 1894 from Cooack Parish at the southern border of the Little Desert and he sent a specimen to Mueller, who labelled it *Cryptandra bifida* (D'Alton 1913). Mueller never stated this fact in any of his publications, but there is a handwritten entry in his personal copy of *Key to the system of Victorian plants, Vol. II* (1885), his last comprehensive account of the Victorian flora, appending *Cryptandra bifida* to the list of Rhamnaceae in Victoria; the copy with copious annotations and additions is held at the library at AD.

***Conservation*:** The species is endemic to a small area near the Little Desert in Victoria. It is listed as 'Endangered', both for Victoria and Australia (Walsh & Stajsic 2007). A national recovery plan has been prepared (Carter & Downe 2006).

***Etymology*:** The epithet derives from the Latin *furcatus*, forked, and the suffix *–ulentus*, indicating marked development, referring to the prominently forked leaves, unique in the *S. halmaturinum* group.

***Specimens examined*: VICTORIA.** LOWAN MALLEE / MURRAY MALLEE: [Precise locality information withheld] Little Desert, NNW of Mt Arapiles Parish Coorak [*sic*], 30 May 1965, *A.C. Beauglehole 19091* (AD, MEL); Cooak [*sic*] Parish, at the southern fringe of Little Desert, northerly from Mitre Lake., 1894, *St.E. D'Alton s.n.* (MEL); Dimboola, 1899, *St.E. D'Alton s.n.* (MEL); N.W. district, 1896, *St.E. D'Alton 5* (MEL); Cooak [*sic*] Settlement Rd, 6 Aug. 1998, *A.C. Cochrane 71, N.G. Walsh & J.G. Eichler* (MEL); Near SE corner Little Desert N.P., bush block, 6 Aug. 1998, *A.C. Cochrane 81, N.G. Walsh & J.G. Eichler* (MEL);

Little Desert, W of Nhill–Gymbowen road, 1 Nov. 1975, *M.G. Corrick 5372* (AD, MEL); Cooack, private property, 21 Sep. 2005, *J.A. Jeanes 1499, N.G. Walsh & H. Rommelaar* (MEL, AD); Cooack Settlement Rd, reserve between road and property fence, 16 Aug. 2001, *J. Kellermann 134, N.G. Walsh & I.R. Thompson* (AD); About midway along an approx. straight line connecting Goroke and Dimboola, 28 Aug. 1972, *O. Thompson & A. Lindner s.n.* (MEL); NE of Nurcoung Public Hall, Cooack Settlement Rd, 24 Feb. 1999, *D.R. Venn s.n.* (MEL); Cooack fire access road, NNW of Mitre, 6 Aug. 1998, *N.G. Walsh 4767* (AD, MEL).

4. *Spyridium halmaturinum* (F.Muell.) F.Muell. ex Benth., *Fl. Austral.* 1: 432 (1863).

M.R.Schomb., *Fl. S Australia* 37 (1875); Tate, *Trans. & Proc. Rep. Roy Soc. South Australia* 3: 66 (1880); *Trans. & Proc. Rep. Roy. Soc. South Australia* 6: 158 (1883); J.M.Black, *Fl. S. Australia* 3: 369 (1926); ed. 2, 3: 550 (1952); H.Eichler, *Suppl. J.M.Black's Fl. S. Austral.* 218 (1965); E.M.Canning in Jessop & Toelken, *Fl. S. Austral.* 2: 815 (1986); W.R.Barker, *J. Adelaide Bot. Gard. Suppl.* 1: 90 (2005). — *Trymalium halmaturinum* F.Muell., *Defin. Austral. Pl.* 42 (1855); *Trans. & Proc. Victorian Inst. Advancem. Sci.* 1: 121 (1855); *Hooker's J. Bot. Kew Gard. Misc.* 8: 40 (1856). Reissek, *Linnaea* 29: 283 (1858). — *Cryptandra halmaturina* (F.Muell.) F.Muell., *Syst. Census. Austral. Pl.* 61 (1882). Tepper, *Trans. & Proc. Rep. Roy. Soc. South Australia* 10: 288 (1888); Tate, *Trans. & Proc. Rep. Roy. Soc. South Australia* 12: 94 (1889); *Second Syst. Census. Austral. Pl.* 104 (1889); Tate, *Handb. Fl. Extratrop. S. Australia* 97 (1890). — *Type citation*: 'On sandy ridges of Kangaroo Island and Encounter Bay'. — *Lectotype (here designated)*: **SOUTH AUSTRALIA.** Kangaroo Island, F. Mueller (MEL 2104215). *Isolectotype:* K (ex Herb. Hookerianum, sheet with loan stamp and number: H/1310/73 20/76). *Residual syntypes:* Sandy scrub, *Waterhouse* (K ex Herb. Hookerianum, sheet with loan stamp and number: H/1310/73 21/76); all syntypes of *S. coactilifolium* (q.v.; see Typification below).

Spyridium bifidum auct. non (F. Muell.) F. Muell. ex Benth.: F.Muell., *Fragm.* 9: 136 (1875), *pro parte*.

Illustrations: E.M. Canning in J.P. Jessop & H.R. Toelken, *Flora of South Australia* 2: 816, fig. 429D (1986); A. Prescott, *It's blue with five petals: Kangaroo Island field guide* 51, fig. 9 (1995); both as *S. halmaturinum* var. *halmaturinum*.

Shrubs 0.3–2 m high, resinous, especially on stipules and bracts; young stems densely pubescent with light brown stellate and long simple hairs, later becoming greyish. *Leaves* alternate: *stipules* ovate to broadly ovate, (1–) 1.8–2.7 (–3.8) mm long, free, reddish-brown, overlapping behind petiole, glabrous on both sides, a few cilia or apical hairs, sometimes hairs along midrib; *petiole* (0.8–) 1.5–2 mm long, densely stellate pubescent; *lamina* broadly obcordate to broadly cuneate or broadly oblong or Y-shaped, (2.7–) 5.5–10 mm long, (2.5–) 4.2–6 (–8) mm wide, base obtuse, margins recurved to revolute, apex shallowly to deeply emarginate, often tridentate, upper surface grey-green, covered with a medium to dense white to greyish indumentum of coarse stalked stellate hairs (some hairs bifid or simple), with hairs breaking off when older so that the hair-bases remain, lower surface with a similar, but usually denser indumentum, hairs on midrib sometimes reddish brown when young. *Floral leaves* usually 5 or 6: (2–) 4.2–5.7 (–9) mm long, (1.8–) 2.8–5.5 (–6.3) mm wide, covered with a very dense, white velvety stellate indumentum. *Inflorescence* a dense head of cymosely arranged ± sessile flowers, (3.5–) 7–11 mm diameter; *bracts* broadly ovate, 1.2–2 mm long, with long cilia and few hairs outside on midrib and lower half. *Flowers* white to cream. *Hypanthium tube* 0.4–0.7 (–0.8) mm long, 1–1.4 (–1.8) mm diameter, with a few long woolly hairs, base with long hairs. *Sepals* 0.6–0.8 mm long, about as long as hypanthium tube, moderately covered with woolly stellate and simple hairs; sepal:tube ratio 1–1.5:1. *Petals* 0.4–0.5 mm long, cucullate, very shortly clawed; limb:claw ratio *c.* 8:1. *Stamens* subequal to the petals, 0.3–0.4 (–0.5) mm long; *anthers c.* 0.2 mm long. *Ovary* inferior, carpels 3, summit glabrous or with very few erect stellate hairs; *style* 0.6–0.8 mm long, minutely 3-lobed. *Infructescence* not or hardly expanding as it matures. *Fruits* ellipsoid to obovoid, 1.7–2.2 mm long, 1.2–1.5 mm wide, dark brown, consisting of 3 papery fruitlets, of which frequently only one develops fully, torus apical, externally glabrous or with a few hairs; *seeds* flattened obovoid, 1.1–1.5 mm long, 0.8–1 mm wide, light brown with dark spots and a darkened base. Fig. 4a–e, Fig.5a–b.

***English name*:** Kangaroo Island spyridium (Canning 1986).

***Distribution & habitat*:** The species occurs mainly in the southern half of Kangaroo Island. It grows in costal heath- and scrubland and low mallee woodland, mainly on shallow sand over limestone, (consolidated) dunes and on limestone cliffs (Fig. 2).

***Phenology*:** Flowering in Aug.–Mar.; fruits recorded in Dec.–Jan.

***Affinities*:** *Spyridium halmaturinum* is closely related to *S. coactilifolium*, *S. fontis-woodii* and *S. furculentum*. All have stipules that are not fused, unlike those of the *S. bifidum* group, and distinctly stalked stellate hairs on their leaves. These hairs have a thickened base, which, when they break off, remains as a conspicuous tubercle (see Fig. 1e).

Spyridium coactilifolium differs from *S. halmaturinum* in its broader, more rounded leaves, which carry a very regular indumentum of stellate hairs, the margin flat to only slightly recurved and the hairs on the midrib and leaf margin of the lower surface rusty in colour; typical *S. halmaturinum* has deeply emarginate Y-shaped to tridentate leaves with revolute margins, a dense to medium indumentum of uniform colour, the midrib on the lower leaf surface only sometimes having rusty hairs. Young stems of *S. coactilifolium* carry a distinct rusty indumentum, in comparison to the light brown indumentum of *S. halmaturinum*.

***Notes*:** Leaf shape and size is quite variable in *S. halmaturinum* (Fig. 4c). Specimens found inland, from around Vivonne Bay and Kelly Hill have smaller and more rounded leaves, and approach *S. fontis-woodii*. However, the inflorescence of this species expands in fruit and displays distinctly tiled bracts; it also differs in its characteristic leaf indumentum.

Spyridium furculentum is the only species in the *S. halmaturinum* group to have deeply Y-shaped leaves, a character that distinguishes it immediately from the other taxa, including *S. halmaturinum*. *Spyridium coactilifolium*, *S. fontis-woodii* and *S. furculentum* are also not very resinous, whereas *S. halmaturinum* is often very resinous and sticky, similar to *S. scabridum*.

***Typification*:** This taxon is endemic to Kangaroo Island. There is one sheet at MEL labelled "Pomaderris (Trymalium) halmaturina Ferd. Mueller / Kangaroo Island Dr M", and this is selected as lectotype. A specimen at K with a similar label is designated as isolectotype. The syntypes from Encounter Bay, cited by Mueller in the protologue are *S. coactilifolium*.

***Conservation*:** The species is scattered to abundant in reserved and unreserved areas across Kangaroo Island and not considered at risk.

***Etymology*:** The epithet is derived from the Latin name of Kangaroo Island, *Insula Halmaturorum* (*halmaturus*: kangaroo), where the species is confined.

***Selected specimens examined:* (c. 150 seen): SOUTH AUSTRALIA.** KANGAROO ISLAND: Main road; southern entry to American River, 22 Oct. 1986, *C.R. Alcock 10659* (AD, HO, I); Hanson Bay, c. 300 m SW of mouth of South West R.; 9 km direct SW of Karatta, 7 Oct. 1982, *W.R. Barker 4507* (AD, MEL); E side of Harriet R. mouth at Vivonne Bay, c. 700 m S of South Coast Rd on road to Vivonne Beach, 9 Oct. 1982, *W.R. Barker 4535* (AD); Loveringa, D'Estrees Bay, c. 500 m NNW of boat ramp corner, 27 Sep. 1995, *W.R. Barker 7521 & F. Udovicic* (AD); Birchmore Lagoon, 27 Sep. 1995, *W.R. Barker 7531 & F. Udovicic* (AD); Between Vivonne Bay to D'Estrees Bay, 10 Oct. 1992, *R. Bates 29405 & R. Cox* (AD, CANB); Kelly Hill Caves, 29 Apr. 1961, *J.B. Clelond s.n.* (AD); 1.6 km NE of Cape Du Couedic lighthouse, 6 Nov. 1989, *P. Copley, C. Baxter & B. Overton NPKI 20078* (AD); c. 25 km SW of Penneshaw on road to Parndana, 20 Dec. 1994, *D.D. Cunninghom 1205 & P. Matthews* (AD, CANB); Kelly Hill, near look-out, 14 Nov. 1958, *H.Eichler 15492* (AD); Kelly Hill C.P., 28 Nov. 2987, *G. Jackson 1894* (AD); Kelly Hill C.P., E of camping area, 19 May 1989, *G. Jockson 1999* (AD); At the base of Mt Stockdale, 17 Sep. 1989, *G. Jackson 2027* (AD); Dudley Peninsula, East-West Rd, between sections 431 and 151, Hundred of Dudley, 3 km NW of Wilson R. crossing on Main Rd, 19 Aug. 1982, *E.N.S. Jackson 4294* (AD, CBG, MEL); South Coast Rd, Eleanor R. crossing, c. 6 km SW from Seal Bay turnoff, 20 Aug. 1982, *E.N.S. Jackson 4349* (AD, CAL, DELHI, SING, ZT); Mt Taylor C.P., hillside of Mt Taylor near cave, 25 Aug. 1982, *E.N.S. Jackson 4481* (AD, CANB, MEL); Section 51, Hundred of Seddon, 3 km SW of Murray Lagoon, 14 Oct. 1986, *D.N. Kraehenbuehl 5613* (AD, CANB, LE); Cape de Couedic lighthouse, car park, 14 Oct. 2009, *J. Kellermonn 496 & 497 & I.M. Kellermann Williams* (AD); Remarkable Rocks, start of loop walk on side of track, 14 Oct. 2009, *J. Kellermann 498–500 et al.* (AD); Eleanor R. crossing, S bridge on W side of road, 17 Oct. 2009, *J. Kellermonn 534–536* (AD); Pt Ellen, c. 200 m N of car park, 17 Oct. 2009, *J. Kellermonn 532* (AD); 5 miles from D'Estrees Bay, 30 Aug. 1964, *M.E. Phillips s.n.* (AD, CANB); Mt Taylor C.P., 7 Oct. 1978, *A.G. Spooner 6066* (AD); Vivonne Bay Rd, 11 Dec. 2006, *M.J. Thorpe 26* (AD, MEL); 50 m SW of Hog Bay Rd and Min Oil Rd intersection, 30 Sep. 1995, *F. Udovicic 261* (AD, CANB, MEL, PERTH); Willson R., Feb. 1894, *Mrs J. Willson jnr s.n.* (AD, MEL, NSW).

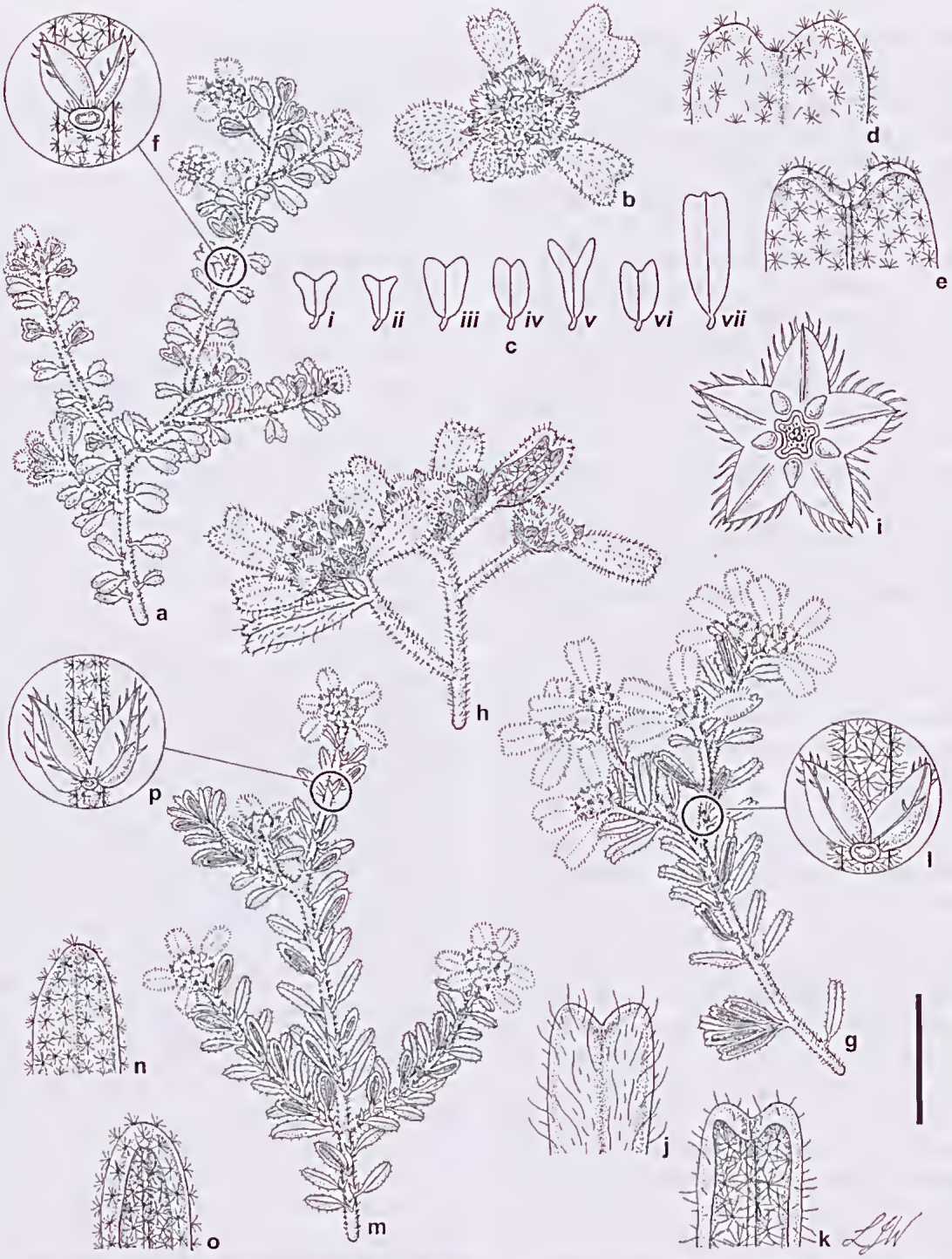

Fig. 4. a–e, *Spyridium halmaturinum*: a, habit; b, inflorescence; c, variations in leaf shape and size; d, upper surface of leaf; e, lower surface of leaf; f, stipules. **g–l, *S. scabridum*:** g, habit; h, inflorescence; i, flower; j, upper surface of leaf; k, lower surface of leaf; l, stipules. **m–p, *S. coalitum*:** m, habit; n, upper surface of leaf; o, lower surface of leaf; p, stipules. a, b, f, *J.Kellermonn 505* (AD 232560); c: [i]*J.B. Clelond s.n.* (AD 966090648), [ii]*P. Copley NPKI 20078 et ol.*, [iv]*J. Kellermonn 506* (AD 232570), [v]*H.M. Cooper s.n.* (AD 96521008), [vi]*B.M. Overton 1994* (AD 99232067), [vii]*F.M. Mowling 75* (AD 98238174); c[iii], d, e, *J. Kellermonn 530* (AD 232569); g, j, k, *J. Kellermann 522*; h, *G. Jackson 887* (AD 97206084); i, *J. Kellermann 503*; l, *V.J. Levitzke 1189* (AD 98639053); m–p, *J. Kellermann 521*. **Scale bar:** a, g, m, 18 mm; b, h, 10 mm; c, 15 mm; d, e, j, k, m, o, 3 mm; i, 1.5 mm; f, l, 3 mm; p, 5.1 mm.

5. *Spyridium scabridum* (Tate) Kellermann & W.R.Barker, *comb. nov.*

Cryptandra scabrida Tate, *Trans. & Proc. Rep. Roy. Soc. S. Australia* 12: 129 (1889) & 12: 62, 94 (1889), *nomen* (see notes below); Tate, *Handb. Fl. Extratrop. S. Australia* 98 (1890). — *Spyridium halmaturinum* var. *scabridum* (Tate) J.M. Black, *Fl. S. Australia* 3: 369 (1926); ed. 2, 3: 550 (1952); E.M. Canning in Jessop & Toelken, *Fl. S. Austral.* 2: 817 (1986); W.R. Barker, *J. Adelaide Bot. Gard. Suppl.* 1: 91 (2005). — *Spyridium scabridum* Tate, *Trans. & Proc. Roy. Soc. S. Australia* 12: 129 (1889), *nom. inval. pro syn.* — *Type citation*: 'By the Eleanor River, and at Karatta, on the Stun'sailboom River, Kangaroo Island (*R.T.*, January 24, 1883)'. — *Lectotype (designated here)*: **SOUTH AUSTRALIA.** Kangaroo Island, 24 Jan. 1883, *R. Tate s.n.* (MEL 2104209, ex Herb. Adelaide Univ.). *Isolectotype*: Kangaroo Island, Jan 1883, [*R. Tate s.n.*] (MEL 2104264, right specimen). *Residual syntype*: Eleanor R., Kangaroo Island, 23 Jan. 1883, [*R. Tate s.n.*] (AD 98132274, ex Herb. R. Tate).

Illustrations: A. Prescott, *It's blue with five petals: Kangaroo Island field guide* 51, fig. 9 (1995), leaf only, as *S. halmaturinum* var. *scabridum*.

Erect, slender mostly single stemmed *shrubs or small trees* to 3 m high, very resinous, especially stipules, bracts, flowers and fruits; young stems densely villous with light brown long stellate and simple hairs, later becoming greyish; mature shrubs with foliage in upper quarter only. *Leaves* alternate: *stipules* ovate, (2–) 3–3.5 (–4.6) mm long, free, abutting or slightly overlapping, often sticking together and appearing fused due to the high resin content, reddish-brown, glabrous, some with hairs along midrib and ciliate, and/or with hairs at apex; *petiole* 1.5–2 mm long, densely long-stellate pubescent; *lamina* oblong to narrowly obovate, 5–11 mm long, 1.5–2.8 mm wide, base obtuse, margins recurved to revolute, apex slightly emarginate to bilobed with a recurved tip, upper surface greyish-green, with a sparse to medium, villous to scabrous cover of simple hairs, sometimes becoming glabrous and tuberculate (from remaining leaf-bases) when older, lower surface with dense to medium indumentum of felted stalked stellate hairs, midrib and sometimes margins with medium to dense long simple hairs, reddish brown when young. *Floral leaves* usually 4–7: obovate, 4–7.3 mm long, 2–4.3 mm wide, covered with a very dense, white felty stellate indumentum with interspersed longer simple hairs. *Inflorescence* loose, compound, consisting of 1–several heads with cymosely arranged ± sessile flowers, 5–12 mm diameter; *bracts* broadly ovate, 2.3–2.8 mm long, with long cilia and long hairs along midrib. *Flowers* white to cream. *Hypanthium tube* 0.5–0.7 mm long, c. 1–1.2 (–1.4) mm diameter, with sparse long simple hairs, base with long hairs. *Sepals* 0.6–0.7 (–0.9) mm long, as long as hypanthium tube, indumentum similar to hypanthium; sepal:tube ratio 1:1. *Petals* 0.4–0.5 (–0.6) mm long, cucullate, clawed; limb:claw ratio c. 4:1. *Stamens* subequal to the petals, 0.4–0.5 mm long; *anthers* c. 0.2 mm long. *Ovary* inferior, carpels 3, summit with dense erect stellate hairs; *style* (0.5–) 0.6–0.8 mm long, minutely 3-lobed. *Infructescence* slightly expanding, often breaking up into smaller unit inflorescences, tiled bracts present. *Fruits* obovoid, 1.7–2 mm long, 1.2–1.5 mm wide, dark brown to black, consisting of 3 papery fruitlets, torus apical, externally glabrous or with a few hairs; *seeds* flattened obovoid 1.2–1.4 mm long, 0.7–0.8 mm wide, light brown to yellow with black mottles and a darkened base. Fig. 4g–l, Fig. 5c.

***Distribution & habitat*:** The taxon is endemic to Kangaroo Island, S.A., and occurs mainly in the interior of the island in heathlands, where it can become a dominant part of the overstorey, and open mallee scrubland on sand over ironstone (Fig. 2).

***English name*:** Rough spyridium (NPWC 2003).

***Phenology*:** Flowering in Sep.–Nov.; fruits recorded in Sep.

***Notes*:** The species was previously treated as a variety of *S. halmaturinum*; however it is separable by its oblong leaves with recurved emarginated tip, the scabrous upper surface resulting from the deciduous stellate hairs, which are represented on older leaves by their tuberculate bases. The loose cymose inflorescences are also diagnostic, being unique in the *S. bifidum – S. halmaturinum* complex; they are not condensed into heads, but are more open, and similar to those of *S. waterhousei* or *S. parvifolium*. The species is very resinous and sticky, especially on bracts and stipules.

The name *C. scabrida* is mentioned in two other articles by Tate (1889a, c) that appear in the same volume of the *Trans. & Proc. Rep. Roy. Soc. S. Australia* before the description of the species, but since the whole volume was published at the same date this does not pose any

Fig 5 a, b, *Spyridium halmaturinum*: a, inflorescence surrounded by floral leaves; b, flowering branch. **c, *S. scabridum*:** inflorescences, open not head-like. **d, *S. coalitum*:** flowering branch with old infructescence (lower left). a, *F. Udovicic 229 & W.R. Barker* (CANB 49164); b, *W.R. Barker 7521 & F. Udovicic*; c, *W.R. Barker 7540 & F. Udovicic* (AD 172359); d, *W.R. Barker 7557 & F. Udovicic*. Photos by F. Udovicic (a) and W.R. Barker (b–d).

nomenclatural problems. Tate's paper on the flora of Kangaroo Island (Tate 1889c) was read to the Society on 4 Dec. 1888, eight months before his description of new species (read 1 Oct. 1889); as such, the name *C. scabrida* was well known before it appeared in print (Dec. 1889). However, no other reference to the name has been found.

Tate changed his mind about the generic placement of the species, as he quoted his manuscript name *Spyridium scabridum* in synonymy. He altered this to *Cryptandra* when the species was published, possibly under the influence of Ferdinand von Mueller, who accepted a largely expanded genus *Cryptandra* (see introduction).

***Typification*:** Two localities are quoted by Tate in the protologue: Eleanor River and Karatta, which are c. 15 km apart. It is unclear whether both were collected on 24 Jan. 1883. All specimens from Eleanor River examined, were collected the day before. The only specimen annotated with the date given in Tate's publication, is selected as lectotype.

***Conservation*:** The taxon is listed as 'Rare' for South Australia (NPWC 2003; Barker 2005; both as *S. halmaturinum* var. *scabridum*).

***Etymology*:** Tate (1889b: 129) explains the use of the epithet *scabridum* as follows: "[u]pper surface of leaves *somewhat rough*". Although the hairs on the leaves of *S. scabridum* are better described as villous or velvety, they break off easily and the hair-bases remain as tubercles, giving the leaves a rough appearance.

***Selected specimens examined* (c. 65 seen): SOUTH AUSTRALIA.** KANGAROO ISLAND: [Precise locality information withheld for conservation reasons] Hog Bay, 26 Sep. 1995, *W.R. Barker 7516, F. Udovicic & R.M. Barker* (AD); E of Borda lighthouse, 29 Sep. 1995, *W.R. Barker 7545 & F. Udovicic* (AD); Car park at start of Cliff Top Trail, 29 Sep. 1995, *W.R. Barker 7554 & F. Udovicic* (AD); Between Mt Taylor and Vivonne Bay, 10 Oct. 1992, *R. Bates 29406 & R. Cox* (AD, CANB, MEL, RSA, STU); Near Vivonne Bay, 2 Mar. 1926, *J.B. Cleland s.n.* (AD); Cape Torrens C.P., 30 June 1996, *R. Davies s.n.* (AD); Flinders Chase N.P. at Ravine des Casoars, 21 Nov. 1963, *H. Eichler 17717* (AD, B, CANB); S of Mt Stockdale, Hundred of Newland, 3 Jan. 1966, *H. Eichler 1B572* (AD); Flinders Chase N.P., road to Scott Cove, 24 Aug. 1982, *E.N.S. Jackson 4459* (AD, SIU, TAI, TI); South Coast Rd, 14 Oct. 2009, *J. Kellermann 502 & 503 et al.* (AD); Scott Cove lookout, 15 Oct. 2009, *J. Kellermann 522 & 523* (AD); Mt Taylor, NW of Vivonne Bay, 19 Sep. 1962, *T.R.N. Lothian 997* (AD); West Bay Track, Flinders Chase N.P., 5 Oct. 1994, *B.M. Overton 2466* (AD); Sandy Creek, 17 Jan. 1984, *E.P. Shore 38* (AD); South Coast Rd, 28 Sep. 1995, *F. Udovicic 241* (CANB); Scott Cove lookout, 29 Sep. 1995, *F. Udovicic 248* (AD, CANB, MEL).

6. *Spyridium coalitum* Kellermann & W.R.Barker, *nom. & stat. nov.*

Spyridium halmaturinum var. *integrifolium* J.M.Black, *Trans. & Proc. Roy. Soc. S. Australia* 49: 273 (1925). J.M.Black, *Fl. S. Australia* 3: 369 (1926); ed. 2, 3: 550 (1952); E.M.Canning in Jessop & Toelken, *Fl. S. Austral.* 2: 817 (1986); W.R.Barker, *J. Adelaide Bot. Gard. Suppl.* 1: 91 (2005). — *Type citation*: 'Kangaroo Island'. — *Lectotype (designated here)*: **SOUTH AUSTRALIA.** Telegraph line near Harvey's Return, Kangaroo Island, Oct. 1908, *H.H.D. Griffith s.n.* (AD 98132270, ex Herb. J.M.Black).

Illustrations: A. Prescott, *It's blue with five petals: Kangaroo Island field guide* 51, fig. 9 (1995), leaf only, as *S. halmaturinum* var. *integrifolium*.

Erect, slender *shrubs* to 2 m high, resinous, especially stipules and bracts; young stems densely pubescent with rusty to light brown stellate and simple hairs, later becoming greyish. *Leaves* alternate: *stipules* broadly triangular to ovate, 2.5–3.6 mm long, fused for about half of their length, reddish-brown, glabrous, sometimes hairs along midrib and at apex; *petiole* 1.8–2.2 mm long, densely stellate pubescent; *lamina* oblong to narrowly elliptic, (4.5–) 6–9.5 (–15) mm long, 2.1–2.5 (–4) mm wide, base obtuse to cuneate, margins revolute, apex entire, obtuse, slightly recurved, upper surface greyish-green, with a sparse to dense cover of stellate hairs, sometimes also simple or bifid hairs, becoming glabrous and tuberculate (from remaining leaf-bases) when older, lower surface with dense to medium dense indumentum of stalked stellate hairs, midrib also with long simple hairs. *Floral leaves* usually 4–7: ovate to broadly elliptic, 4–7.3 (–10) mm long, 2.5–4 (–6) mm wide, covered with a very dense, white felty stellate indumentum with interspersed longer simple hairs. *Inflorescence* a head of cymosely arranged ± sessile flowers, 5–13 mm diameter; *bracts* in fused pairs, broadly ovate, c. 2.3 mm long, with long cilia and hairs along midrib. *Flowers* white to cream. *Hypanthium tube* c. 0.5 mm long, 0.8–1.1 mm diameter, with sparse long flexuose simple and stellate hairs, base with long hairs. *Sepals* c. 0.6 mm long, about

Key to subspecies

1. Leaf lamina Y-shaped, cuneate to obcordate, deeply emarginate ..... **7a. subsp. *bifidum***
1: Leaf lamina narrowly oblanceolate or narrowly oblong or linear, entire, rarely emarginate at apex..... **7b. subsp. *wanillae***

as long as hypanthium tube, with an indumentum of mainly short simple hairs; sepal:tube ratio 1.2:1. *Petals* (0.3–) 0.4–0.5 mm long, cucullate, clawed; limb:claw ratio c. 2:1. *Stamens* subequal to the petals, c. 0.4 mm long; *anthers* c. 0.2 mm long. *Ovary* inferior, carpels 3, summit with dense erect stellate hairs; *style* 0.5–0.8 mm long, minutely 3-lobed. *Infructescence* expanding as it matures, so tiled bracts are visible. *Fruits* ellipsoid to obovoid, c. 2.5 mm long, 1.5–1.8 mm wide, dark brown, consisting of 3 papery fruitlets, torus apical, externally ± glabrous; *seeds* flattened obovoid 1.4–1.6 mm long, 1–1.1 mm wide, light brown with black mottles and a darkened base. Fig. 4m–p, Fig. 5d.

***Distribution & habitat*:** The taxon is endemic to Kangaroo Island, S.A., and occurs mainly along the northwest coast near Cape Borda with a few scattered records further inland. It grows in coastal mallee heath, shrubland and eucalypt forests in shallow sand over limestone and on limestone cliffs; few records are from ironstone (Fig. 2).

***English name*:** Flinders Chase spyridium (Biological Survey 2004).

***Phenology*:** Flowering in Sep.–Nov.; fruits recorded in Sep.

***Affinities*:** The species was previously a variety of *S. halmaturinum*. Important characters that distinguish *S. coalitum* are simple leaves, fused stipules and the dense indumentum on the ovary surface.

***Notes*:** Although stellate hairs are usually present on the upper leaf-surface of *S. coalitum*, some specimens also have simple or bifid hairs.

***Typification*:** Only one specimen of this taxon is known from Black's herbarium at AD. This is here designated as the lectotype.

***Conservotion*:** Most populations of the species are in Flinders Chase National Park or the Ravines des Casoars Wilderness Protection Area, and are well conserved.

***Etymology*:** The epithet is derived from the Latin *coalitus*, united by growth, in reference to the stipules of the species that are united and fused together for about half of their length. This is in contrast *S. halmaturinum*, which has free stipules.

***Selected specimens examined* (40 seen): SOUTH AUSTRALIA.** KANGAROO ISLAND: Snug Cove, 2 Nov. 1986, *R.J. Bates 7701* (AD); Flinders Chase N.P., West Coast Rd, c. 3.5 km by road N of West Bay turnoff, c. 3 km direct NE of West Bay, 7 Oct. 1982, *W.R. Barker 4500 & L. Haegi* (AD, MEL); Cape Borda Lighthouse; 50–100 m W of houses, 29 Sep. 1995, *W.R. Barker 7543 & F. Udovicic* (AD); 100 m W of Scott Cove lookout, 29 Sep. 2995, *W.R. Barker 7557 & F. Udovicic* (AD); 0.9 km WSW of Cape Borda Lighthouse, 8 Nov. 1989, *D. Canty & G. Ashman NPKI 10085* (AD); Flinders Chase, 2 Feb. 1948, *J.B .Cleland s.n.* (AD); Flinders Chase N.P., clay pan c. 4 km ESE by road from car park at West Bay, more NW of 2 clay pans in area, 23 Aug. 1982, *E.N.S. Jackson 4432* (AD, IBSC, LJU, LSU); Cape Borda, Cliff Top Hike N of lighthouse, 15 Oct. 2009, *J. Kellermann 519–521* (AD); Cape Borda, 29 Aug. 1964, *M.E. Phillips 420* (AD, CBG, L); 8 miles [12.8km] from Rocky River, SE towards Cape Borda, 29 Sep. 1965, *M.E. Phillips 1017* (CANB, MEL); 2.65 km SW of Snug Cove, 10 Nov. 1989, *A. Robinson & C. Halstead NPKI 10181* (AD); 1 km E of Snake Lagoon, 7 Nov. 1989, *A. Robinson & C. Halstead NPKI 10620* (AD, MEL); Flinders Chase, c. 24 km along the West Bay Track from Rocky River Homestead, 21 Oct. 1968, *J.R. Wheeler 1300* (AD).

7. *Spyridium bifidum* (F.Muell.) F.Muell. ex Benth., *Fl. Austral.* 1: 432 (1863).

M.R.Schomb., *Fl. S. Australia* 37 (1875); F.Muell., *pro parte*; *Fragm.* 9: 136 (1875), *pro parte*; Tate, *Trans. & Proc. Rep. Roy Soc. South Australia* 3: 66 (1880), *pro parte*; J.M.Black, *Fl. S. Australia* 3: 369 (1926), *pro parte*; ed. 2, 3: 550 (1952), *pro parte*; E.M.Canning in Jessop & Toelken, *Fl. S. Austral.* 2: 817 (1986), *pro parte*; W.R.Barker, *J. Adelaide Bot. Gard. Suppl.* 1: 90 (2005), *pro parte*. — *Trymalium bifidum* F.Muell., *Defin. Austral. Pl.* 42 (1855); *Trans. & Proc. Victorian Inst. Advancem. Sci.* 1: 121 (1855); *Hooker's J. Bot. & Kew Gard. Misc.* 8: 40 (1856). — *Trymalium bifidum* F.Muell. *emend.* Reissek, *Linnaea* 29: 282 (1858). — *Cryptandra bifida* (F.Muell.) F.Muell., *Syst. Census. Austral. Pl.* 61 (1882), *pro parte*. *Second Syst. Census Austral. Pl.* 104 (1889), *pro parte*; Tate, *Trans. & Proc. Rep. Roy. Soc. South Australia* 12: 94 (1889), *pro parte*; *Handb. Fl. Extratrop. S. Australia* 98 (1890), *pro parte*. — *Type citation*: 'In the Marble Ranges and on the coast of Spencer's Gulf, at Boston Point. C. Wilhelmi.' — *Lectotype (here designated)*:

SOUTH AUSTRALIA. Marble Range, *C. Wilhelmi s.n.* (MEL 233423, ex Herb. Sonder; sterile material). *Residual syntypes*: "Marble Range & Port Lincoln, 1855", *C. Wilhelmi s.n.* (K, sterile specimen with loan stamp H/1310/95 22/76); "Boston Pt. Marble Ra.", *C. Wilhelmi s.n.* (K 356451 *n.v.*, photo at MEL 2264224, ex Herb. F.Muell., left hand specimen); "Boston Point, in montib. sicc. humil., florifer!" [in low, arid hills, flowering], *C. Wilhelmi s.n.* (MEL 233422); "Boston Point", *C. Wilhelmi s.n.* (BM 793990 *n.v.*, photo at MEL 2264225, right hand specimen); all types of *Trymalium stenophyllum* Reissek (see below). *Epitype (here designated)*: **SOUTH AUSTRALIA.** Marble Range, E of N/S Block Saddle, very close to road junction at base of road across saddle, Eyre Peninsula, S.A., B Oct. 1995. *W.R. Barker 7601 & R.M. Barker* (AD 173237). *Isoepitypes*: B, BM, BRI, CANB, MEL, MO, NSW, NT, NY, PERTH, SI, US, W.

Erect *shrubs* to 2 m high, not resinous; young stems densely pubescent with intertwined stellate and simple hairs. *Leaves* alternate: *stipules* triangular to narrowly ovate, (1.4–) 1.8–3 mm long, fused for 1/2 to 3/4 of their length, ciliate towards apex, midrib with long simple hairs, glabrescent with age; *petiole* 0.7–1.5 (–1.7) mm long, densely stellate pubescent, soon glabrous; *lamina* 3.2–13 mm long, 1–5 mm wide, base cuneate, margins ± revolute, upper surface green, covered with a medium dense white to greyish indumentum of long antrorse simple hairs, lower surface sparsely to densely covered with small stalked stellate hairs, midrib also with simple antrorse hairs. *Floral leaves* usually 5–8: broader than stem leaves, 3–10 mm long, 1.5–6 mm wide, covered with a very dense, white felted indumentum. *Inflorescence* a dense globular head of cymosely arranged ± sessile flowers, 8–12 mm diameter; *bracts* in fused pairs, ovate to broadly ovate, 1.7–3 mm long, with long cilia. *Flowers* white, covered in dense long simple hairs overlying fewer stellate hairs. *Hypanthium tube* 0.6–0.8 mm long, 1.4–2 mm diameter, tube sparsely to moderately dense pubescent with simple hairs, base densely pubescent with short stellate and overlying long simple hairs. *Sepals* 0.7–0.9 mm long, with dense tufts of simple hairs at apices. *Petals* 0.4–0.6 mm long, cucullate, clawed. *Stamens* subequal to the petals, 0.5–0.7 mm long; *anthers* 0.2–0.3 mm long. *Ovary* inferior, carpels 3, summit densely pubescent with stellate hairs; *style* 0.6–0.8 mm long, stigma 3-lobed. *Infructescence* not or hardly expanding. *Fruits* obovoid, 2.2–2.5 mm long, 1–1.4 mm wide, light brown, consisting of 3 papery fruitlets, of which usually only one develops fully, torus ± apical, fruit wall densely pubescent; *seeds* flattened obovoid, 1.4–1.7 mm long, 0.8–1 mm wide, light brown with a darkened base.

***Distribution & habitat*:** The species consists of two subspecies which occur on Marble Range and the hills east of Edillilie, Eyre Peninsula, S.A., their ranges of distribution only 5–6 km apart. Habitat is summarised under the subspecies.

***Affinities*:** It is closely related to *S. stenophyllum*, which differs in having narrower leaves, smaller flower heads, an ovary with two carpels and a style with two stigmatic lobes. Also possibly allied is *S. leucopogon*, an entire-leaved species that occurs further to the south on the coast of Eyre Peninsula. It has shorter habit, smaller heads and smaller leaves with a recurved apex. This relationship is being investigated in broader revisional studies.

***Typification*:** The typification of this species is complex. When Mueller published *T. bifidum*, he also included material of the taxon now known as *S. stenophyllum*. He quotes specimens from Marble Range and Boston Point, two localities about 45 km apart. In our concept of the species, *S. bifidum* is endemic to the Marble Range region and the taxon from Boston Point is *S. stenophyllum*. However, there are specimens of *S. bifidum* labelled as coming from "Marble Ra." and "Boston Pt". On one sheet, a single twig is labelled as coming from Marble Range and Port Lincoln at the same time. Another sheet has one label "Boston Point Marble Range" with two specimens, one each of *S. bifidum* and *S. stenophyllum*. Hence, we assume that collections of the taxon labelled as coming from Boston Point are labelled wrongly. Since Mueller thought that the specimens from the two localities were the one species, they were most likely mixed up when he sent them out to other herbaria.

We designate the only sheet unambiguously labelled as from Marble Range as the lectotype of *S. bifidum*. All other sheets have either Boston Point as collecting locality or both Boston Point and Marble Range. Unfortunately the lectotype is a sterile specimen. Apart from leaf shape and indumentum, the number of carpels and stigma lobes is an important character

to distinguish between *S. stenophyllum* and *S. bifidum*. Since the lectotype does not have any flowers, a recently collected flowering specimen is designated as epitype to clearly fix the name *S. bifidum*.

***Etymology*:** The epithet is Latin and refers to the forked leaves of the species.

7a. *Spyridium bifidum* subsp. *bifidum*

Spyridium bifidum var. *Marble Range* (*W.R.Barker 7601*) W.R.Barker, *J. Adelaide Bot. Gard. Suppl.* 1: 90 (2005).

Slender, erect *shrubs* to 2 m high, not resinous; young stems densely pubescent with white dense intertwined stellate and simple hairs, later becoming greyish. *Leaves* alternate: *stipules* triangular to narrowly ovate, (1.5–) 2–3 mm long, fused for 1/2 to 3/4 of their length, ciliate towards apex, midrib with long simple hairs, glabrescent with age; *petiole* 0.7–1.5 (–1.7) mm long, densely stellate pubescent, soon glabrous; *lamina* Y-shaped, cuneate to narrowly obcordate, 3.2–10 mm long, 1.9–5 mm wide, base cuneate, margins ± revolute, apex deeply emarginate for up to 1/2 of leaf's length, upper surface green, covered with a medium dense white to greyish indumentum of long antrorse simple hairs, lower surface sparsely to densely covered with small stalked stellate hairs, midrib also with simple antrorse hairs. *Floral leaves* usually 5–8: broader than stem leaves, 3–10 mm long, 2.2–6 mm wide, covered with a very dense, white felted stellate indumentum. *Inflorescence* a dense globular head of cymosely arranged ± sessile flowers, (8–) 10–12 (–15) mm diameter, often several heads are crowded together and appear even larger; *bracts* in fused pairs, ovate to broadly ovate, 1.7–3 mm long, with long cilia, long hairs along midrib, and fewer hairs outside. *Flowers* white, covered in dense long simple hairs overlying fewer stellate hairs. *Hypanthium tube* 0.6–0.8 mm long, (1.5–) 1.7–2 mm diameter with sparse simple hairs, base densely pubescent with short stellate and overlying long simple hairs. *Sepals* 0.7–0.9 mm long, about as long as hypanthium tube, with dense tufts of simple hairs at apices; sepal:tube ratio 1:1.2. *Petals* 0.5–0.6 mm long, cucullate, long-clawed; limb:claw ratio *c.* 2:1. *Stamens* subequal to the petals, c. 0.6 mm long; *anthers* 0.2–0.3 mm long. *Ovary* inferior, carpels 3, summit densely pubescent with stellate hairs; *style* 0.7–0.8 mm long, stigma 3-lobed. *Infructescence* globular, expanding up to 20 mm diam.; bracts not tiled. *Fruits* obovoid, 2.4–2.5 mm long, 1.2–1.4 mm wide, light brown, consisting of 3 papery fruitlets, of which usually only one develops fully, torus ± apical, fruit wall densely pubescent; *seeds* flattened obovoid, 1.6–1.7 mm long, c. 1 mm wide, light brown with a darkened base. Fig. 6a–e., Fig. 8a–b.

***English name*:** Marble Range spyridium (NPWC 2003).

***Distribution & habitat*:** The typical subspecies is endemic to the Marble Range, Eyre Peninsula (Fig. 2), where it occurs in open mallee shrubland on quartzite and sometimes on sand over laterite.

***Phenology*:** Flowering in June–Sep.; fruits recorded in Oct.

***Notes*:** Black (1926, 1952) recognised the distinctiveness of Marble Range populations, referring to it as the "large leaved form of *S. bifidum* from Marble Range".

***Conservation*:** The taxon is restricted to a localised line of hills, the Marble Range. It is listed as 'Vulnerable' in South Australia (NPWC 2003, Barker 2005; as *S. bifidum* var. *Marble Range*).

***Selected specimens examined* (30 seen): SOUTH AUSTRALIA.** EYRE PENINSULA: [Precise locality information withheld for conservation reasons] N Block of Marble Range, 26 Jun. 1966, *A. Ainslie s.n.* (AD); Marble Range, Hundred of Warrow, 25 Aug. 1967, *C.R. Alcock 1401* (AD); Population nearest top of saddle of N/S blocks, 8 Oct. 1995, *W.R. Barker 7602 & R.M. Barker* (AD); E of Marble Range, Sep. 1982, *R.J. Bates 2284* (AD); W of Edillilie, 26 Oct. 1988, *D. Hopton 243* (AD, CANB); SSE of Coulta, Site: BS128-MAR00601, Patchid: 20218, 9 Sep. 2004, *P.J. Lang, P.D. Canty & R.S. Johnson BS128-3156* (AD); Marble Ra., E face, 30 Sep. 1979, *D.E. Symon 11665* (AD, BH, LG); Marble Ra., 30 Sep. 1979, *J.Z. Weber 6029* (AD, CAL, DUH); 6 km W of Edillilie, 15 June 1975, *L.D. Williams 6694* (AD).

7b. *Spyridium bifidum* subsp. *wanillae* Kellermann & W.R.Barker, *nom. & stat. nov.*

Spyridium bifidum var. *integrifolium* J.M. Black, *Trans. & Proc. Roy. Soc. S. Australia* 49: 273 (1925). J.M. Black, *Fl. S. Australia* 3: 369 (1926); ed. 2, 3: 550 (1952); E.M. Canning *in* Jessop & Toelken, *Fl. S. Austral.* 2: 817 (1986). — *Type citation*: 'Port Lincoln to Marble Range, E.P.' — *Lectotype (here designated)*: **SOUTH AUSTRALIA.** Port Lincoln, 10 Oct. 1909, *H.H.D. Griffith s.n.* (AD 96820287, ex Herb. J.M. Black). *Isolectotype*: MEL 2104812 [*J.M. Black 12*]. *Residual syntype*: Marble Range, *s.coll.* (AD 97610493, ex Herb. R. Tate, determined by J.M. Black).

Fig. 6. a–e, *Spyridium bifidum* subsp. *bifidum*: a, habit; b, upper surface of leaf; c, lower surface of leaf; d, stipules; e, fruit. **f–h, *S. bifidum* subsp. *wonilloe*:** f, habit; g, upper leaf surface; h, lower leaf surface. **i–m, *S. stenophyllum* subsp. *stenophyllum*:** i, habit; j, part of flower with 2-fid stigma; k, upper surface of leaf; l, lower surface of leaf; m, stipules. **n–p, *S. stenophyllum* subsp. *renovotum*:** n, habit; o, upper surface of leaf; p, lower surface of leaf. **q, Example of hybridisation** (leaf shape and venation)**:** [i]*S.stenophyllum* subsp. *renovotum*, [ii]presumed hybrid, [iii]*S. porvifolium*. a, *D.J.E. Whibley 1B74* (AD 96740055); b–d, *P.J. Lang et al. BS128-3156*; e, *W.R. Barker 7603*; f–h, *W.R. Barker 7591* (AD 173226); i, *D.J.E. Whibley 5757*; j–m, *F.J. Bodman 11156*; n–p, q [i] *J. Kellermann 471 et ol.*; q: [ii]*J. Kellermann 467* (AD 232470), [iii]*J. Kellermonn 469* (AD 232472). **Scale bar:** a, f, i, n, 13.8 mm; b, c, g, h, k, l, o, p, 3 mm; d, m, 3 mm; e, j, 1.5 mm; q, 9.6 mm.

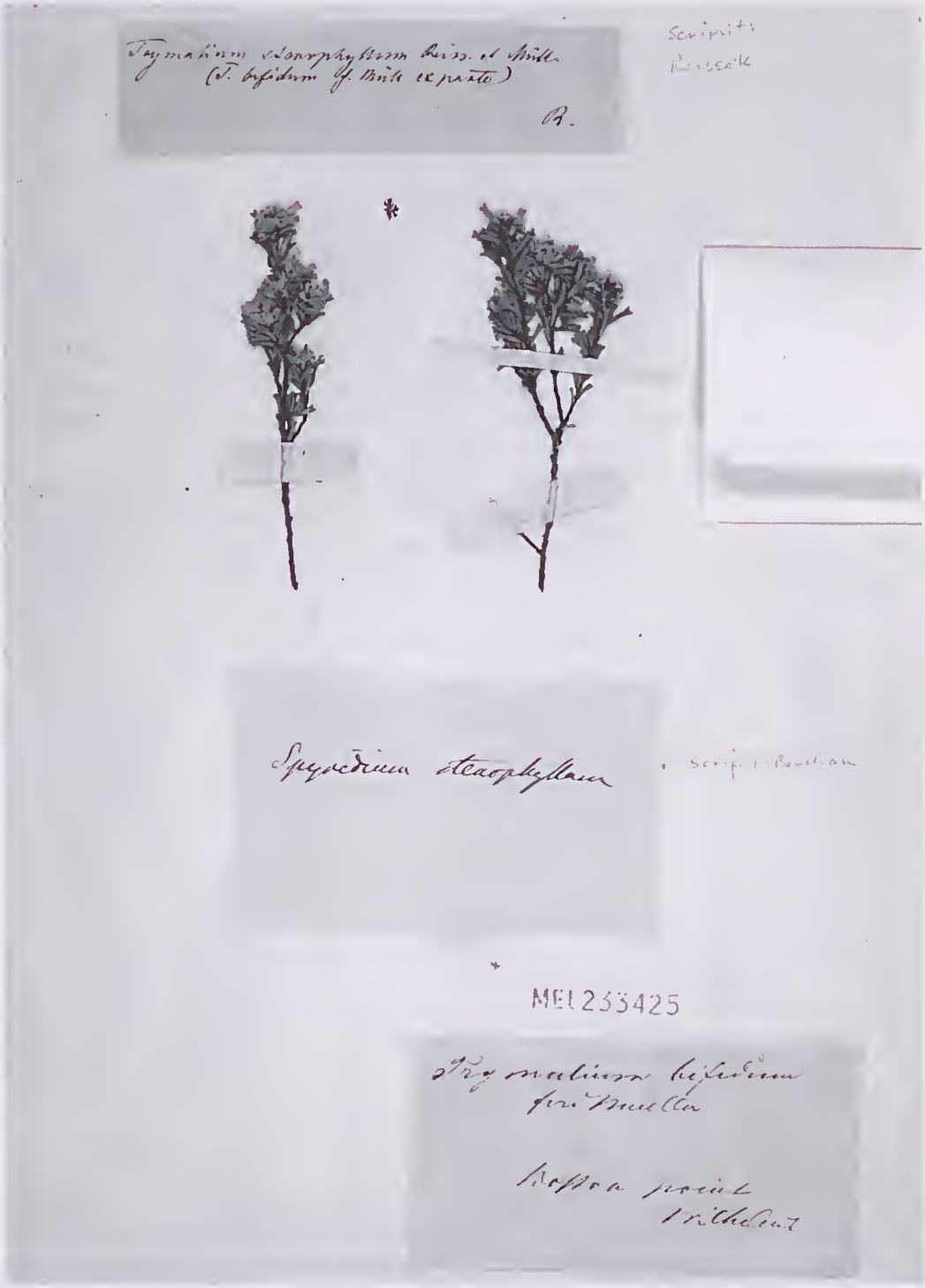

Fig. 7. Lectotype of *Spyridium stenophyllum* (Reissek) Kellermann & W.R.Barker (MEL 233425, part of sheet). The determinavit slips were written by F. von Mueller (original determination with his 1855 name: '*Trymalium bifidum* / FerdMueller / Boston Point / Wilhelmi'; bottom label), S. Reissek (after splitting this species from *T. bifidum* in 1858: '*Trymalium stenophyllum* Reiss. et Müll. / (*T. bifidum* F.Müll ex parte) / R.'; top label) and G. Bentham, during the preparation of *Flora Australiensis* (early 1860s, Rhamnaceae was published 1863, using the unpublished name '*Spyridium stenophyllum*'; middle label).

Key to subspecies

1. Leaves: upper surface glabrous; leaf-lobes mucronate, apex recurved ..... **8a. subsp. *stenophyllum***
1: Leaves: upper surface with simple, antrorse hairs; leaf-lobes ± obtuse, apex hidden by a tuft of hairs ..... **8b. subsp. *renovatum***

Spyridium bifidum var. *Wanilla* (*K. Clipstone 88*) W.R.Barker in Jessop, *List Vasc. Pl. S. Austral.*, ed. 4, 55 (1993). W.R.Barker, *J. Adelaide Bot. Gard. Suppl.* 1: 90 (2005).

Erect *shrubs* to 2 m high, not resinous; young stems densely pubescent with white (very rarely rusty) intertwined stellate and simple hairs, later becoming greyish. *Leaves* alternate: *stipules* triangular, (1.4–) 1.8–3 mm long, fused for 1/2 to 3/4 of their length, ciliate towards apex, outside with long simple hairs, especially along midrib, glabrescent when older (sometimes also when young); *petiole* 1–1.5 mm long, densely stellate pubescent, soon glabrous; *lamina* narrowly oblanceolate or narrowly oblong or linear, 5–13 mm long, 1–1.5 (–2) mm wide, base cuneate, margins revolute, apex entire, obtuse to apiculate, rarely emarginate or 2-lobed, upper surface green, covered with a medium dense white to greyish indumentum of antrorse simple hairs, lower surface sparsely to densely covered with small stellate hairs, midrib also with simple antrorse hairs. *Floral leaves* usually 5 or 6: broader than stem leaves, 5–7 mm long, 1.5–2 mm wide, covered with a very dense, white felted indumentum of stellate and longer simple hairs. *Inflorescence* a dense globular head of cymosely arranged ± sessile flowers, 8–12 mm diameter; *bracts* in fused pairs, ovate to broadly ovate, 2–3 mm long, with long cilia, rarely hairs along midrib, and fewer hairs outside. *Flowers* white, covered in dense long simple hairs overlying fewer stellate hairs. *Hypanthium tube* 0.6–0.8 mm long, 1.4–1.6 mm diameter with sparse to moderately dense simple hairs, base densely pubescent with short stellate and overlying long simple hairs. *Sepals* 0.7–0.8 mm long, about as long as hypanthium tube, with dense tufts of simple hairs at apices; sepal:tube ratio 1:1–1.2. *Petals* 0.4–0.6 mm long, cucullate, long-clawed; limb:claw ratio c. 5:2. *Stamens* subequal to the petals, 0.5–0.7 mm long; *anthers* 0.2–0.3 mm long. *Ovary* inferior, carpels 3, summit densely pubescent with stellate hairs; *style* 0.6–0.8 mm long, stigma 3-lobed. *Infructescence* not or hardly expanding. *Fruits* obovoid, c. 2.2 mm long, 1–1.2 mm wide, light brown, consisting of 3 papery fruitlets, of which usually only one develops fully, torus ± apical, fruit wall densely pubescent; *seeds* flattened obovoid, 1.4–1.5 mm long, c. 0.8 mm wide, light brown with occasional black mottles and a darkened base. Fig. 6f–h, Fig. 8c.

***English name*:** Wanilla spyridium (NPWC 2003).

***Distribution & habitat*:** This taxon occurs in the area around Wanilla, Eyre Peninsula (Fig. 2). It grows in mallee shrubland with *Eucalyptus incrassata* Labill. and *Melaleuca uncinata* R.Br. on sand over laterite and ironstone.

***Phenology*:** Flowering in July; fruits recorded in Oct.

***Notes*:** Black described this taxon as *S. bifidum* var. *integrifolium* from the Eyre Peninsula, and cited this locality also in his *Flora of South Australia*. In her treatment of *S. bifidum* var. *integrifolium* Canning (1986) cites Kangaroo Island as the area of occurrence. This error was perpetuated in several other publications (e.g. Barker 2005). It is not clear to which taxon Canning applied the name, but the entire-leaved species from Kangaroo Island referred to is most likely *S. coalitum*, *S. vexilliferum* or other similar species.

Hairs on the upper surface of the leaves are usually longer in subsp. *wanillae* than in subsp. *bifidum*; one specimen has near-glabrous leaves (*Bates 37251*). Rarely, some flowers of a specimen display two stigmatic lobes (*Udovicic 294*, CANB 480356).

Occasionally flowers of subsp. *wanillae* have only a rudimentary style or rudimentary stamens.

There are also presumed hybrids with *S. vexilliferum*, where both species co-occur; these plants show intermediate characters between the two taxa (e.g., *Barker 7588 & 7589, Udovicic & Barker*, AD 173223 & AD 173224).

The Marble Range location of *Smyth 2* needs confirmation. It is the location of subsp. *bifidum* and the two subspecies are otherwise allopatric on ranges a few kilometres apart on either side of a broad valley. A confusion of localities could easily have arisen.

***Typification*:** A specimen with Black's annotations from his herbarium at AD is selected as lectotype. On this sheet he notes that a duplicate of this collection was forwarded by him to A.J. Ewart in Melbourne as "no. 12"; this specimen is now at MEL. A specimen labelled as "Marble Ra." is a residual syntype, which was presumably collected more at the S end of the Range, towards Wanilla.

***Conservation*:** The taxon is listed as 'Vulnerable' in South Australia, with some populations reserved in Wanilla Conservation Park (NPWC 2003, 8arker 2005; as *S. bifidum* var. Wanilla).

***Etymology*:** The epithet refers to the location of the taxon, Wanilla, which is applied to the Hundred[1] and one of the towns to the west. It is treated as a noun in genitive form.

***Selected specimens examined* (22 seen): SOUTH AUSTRALIA.** EYRE PENINSULA: [Precise locality information withheld for conservation reasons] E of township of Wanilla, NW of Port Lincoln, Hundred of Wanilla, 6 July 1965, *C.R. Alcock s.n.* (AD); Nicho's Nooky, 8 Oct. 1995, *W.R. Barker 7604 & R.M. Barker* (AD);Wanilla C.P., 7 Oct. 1995, *W.R. Barker 75B6, F. Udovicic & R.M. Barker* (AD); Hills S of Ungarra, 19 July 1994, *R. Botes 37251* (AD, MEL); W of Wanilla, 1 June 1982, *K. Clipstone BB* (AD); Adjacent Wanilla C.P., 26 Oct. 1989, *D. Hopton 232–234* (AD, CANB); "E side of Marble Ra.", Oct. 1993, *J. Smyth 2* (AD); Wanilla–North Shields Rd, 3 Mar. 1993, *N.G. Walsh 4002* (AD, MEL); E of Wanilla, 30 Aug 1976, *D.J.E. Whibley 5712* (AD, UWM).

8. *Spyridium stenophyllum* (Reissek) Kellermann & W.R.Barker, *comb. nov.*

Trymalium stenophyllum Reissek, *Linnaea* 29: 282 (1858). — Type citation: '8oston Point (Wilhelmi).' — *Lectotype (here designated)*: **SOUTH AUSTRALIA.** 8oston Point, *C. Wilhelmi s.n.* (MEL 233425, ex Herb. Reissek; Fig. 5). *Isolectotype*: MEL 233426 (ex Herb. Sonder). *Residual syntypes*: "8oston Point Marble Range", *C. Wilhelmi s.n.* (K 356451 *n.v.*, photo at MEL 2664224, right hand specimen); "Marble Range", *C. Wilhelmi s.n.* (8M 793990 *n.v.*, photo at MEL 2264225, left hand specimen); "Marble Ra.", *C. Wilhelmi s.n.* (MEL 233424).

Spyridium bifidum auct. non (F.Muell.) F.Muell. ex 8enth.: 8enth., *Fl. Austral.* 1: 432 (1863); Schomb., *Fl. S. Austral.* 37 (1875); Tate, *Trans. & Proc. Rep. Roy Soc. South Australia* 3: 66 (1880); J.M.8lack, *Fl. S. Australia* 3: 369 (1926), *pro parte*, ed. 2, 3: 550 (1952), *pro parte*; E.M.Canning in Jessop & Toelken, *Fl. S. Austral.* 2: 815 (1986), *pro parte*; W.R.8arker, *J. Adelaide Bot. Gard. Suppl.* 1: 90 (2005), *pro parte*.

Cryptandra bifida auct. non (F.Muell.) F.Muell.: F.Muell., *Syst. Census. Austral. Pl.* 61 (1882), *pro parte*. *Second Syst. Census Austral. Pl.* 104 (1889), *pro parte*; Tate, *Trans. & Proc. Rep. Roy. Soc. South Australia* 12: 94 (1889), *pro parte*; Tate, *Handb. Fl. Extratrop. S. Australia* 98 (1890), *pro parte*.

Shrubs to 1.2 m high, resinous; young stems densely pubescent with stellate hairs, especially on young stipules and bracts. *Leaves* alternate: *stipules* triangular to narrowly ovate, 2–3.8 (–6) mm long, fused for more than half of their length, reddish-brown, glabrous, with hairs along midrib and cilia towards apex; *petiole* 0.9–2.2 mm long, glabrous to sparsely pubescent; *lamina* narrowly Y-shaped to narrowly cuneate, (3.4–) 3.8–7.5 (–9.5) mm long, 1.2–2.8 mm wide, base cuneate, margins revolute, apex deeply to shallowly emarginate or bilobed, upper surface green, lower surface with dense to medium dense indumentum of stellate hairs, midrib with long simple hairs. *Floral leaves* usually 3–5: broader than stem-leaves, 3.2–7 mm long, 1.6–2.8 mm wide, covered with a very dense, white felty stellate indumentum, often interspersed longer simple hairs. *Inflorescence* a globular head of cymosely arranged ± sessile flowers, 6–11 (–12) mm diameter; *bracts* in fused pairs, broadly ovate, 2–3 mm long, with long cilia. *Flowers* white to cream. *Hypanthium tube* 0.4–0.5 (–0.8) mm long, (1.2–) 1.4–1.7 mm diameter, tube pubescent or glabrous, base densely pubescent with short stellate and overlying long hairs, often flexuous. *Sepals* 0.5–1 mm long with an indumentum of mainly short simple or stellate hairs, especially towards tip. *Petals* 0.4–0.7 (–0.8) mm long, cucullate, clawed. *Stamens* subequal to the petals, 0.3–0.6 mm long; *anthers* c. 0.2 mm long. *Ovary* inferior, carpels 2, summit with dense stellate hairs; *style* 0.6–0.8 (–1) mm long, minutely bilobed. *Infructescence* slightly expanding, but no tiled bracts visible. *Fruits* obovoid to ellipsoid, 1.7–2 mm long, 1.3–1.5 mm wide, light brown, consisting of 1–2 papery fruitlets, torus apical, fruit wall densely pubescent; *seeds* 1–1.4 mm long, 0.8–1 mm wide, brown with a darkened red-brown base.

1. S.A. is traditionally divided into Counties, Hundreds and Sections (see Landbeater 2006–).

***Distribution & infraspecific variation*:** The species has two subspecies, which occur throughout most of Eyre Peninsula and adjacent regions further east.

***Affinities*:** The species is closely related to *S. bifidum*, which differs in having slightly broader leaves that are always covered with antrorse simple hairs, larger flower heads, an ovary with three carpels and a style with three stigmatic lobes.

***Notes*:** This species is the only species in the genus *Spyridium* with two carpels and a bilobed style. Usually only one carpel matures, resulting in a one-seeded fruit. It is one of a few species of Pomaderreae with bilocular ovaries, the other taxa being the genus *Polianthion* K.R.Thiele (Kellermann *et al.* 2006), several species of *Cryptandra* (Rye 1995a, 2008) and the typical subspecies of *Trymalium odoratissimum* Lindl. (Rye 1995b,

Fig 8. a,b, *Spyridium bifidum* subsp. *bifidum*: a, inflorescence surrounded by floral leaves; b, flowering branch; **c, *S. bifidum* subsp. *wanillae*:** inflorescence. **d, *S. stenophyllum* subsp. *renovatum*:** branches with old infructescence (upper right). a, b, *W.R. Barker 7601 & R.M. Barker*; c, *W.R. Barker 7586 et al.*; d, *J. Kellermann 471 et al.* Photos by W.R. Barker (a–c) and J. Kellermann (d).

as *T. floribundum* Steud.; Kellermann *et al.* 2008).

***Typification*:** The typification of *S. stenophyllum* is closely linked with that of *S. bifidum*. Reissek split Mueller's *T. bifidum* into two species: specimens from Marble Range retained the name *T. bifidum*, while specimens from Boston Point were described as a new taxon, *T. stenophyllum*. There are no syntypes of the taxon at W, where Reissek's original herbarium is deposited (E. Vitek, pers. comm., Jan. 2008), but MEL has a sheet from Reissek's herbarium (Fig. 7), which is labelled by Mueller as *T. bifidum* and by Reissek as *T. stenophyllum*. This specimen is designated as lectotype. Another small specimen at MEL from the Sonder Herbarium is an isolectotype.

The lectotype also has a label by Bentham, who examined Mueller's herbarium for preparation of *Flora Australiensis*. He already recognised that the species belonged to *Spyridium* and labelled it as '*Spyridium stenophyllum*', although in his flora treatment he subsumed the taxon into *S. bifidum* (Bentham 1863). As such Bentham was the first person to — albeit not formally — consider combining the epithet with the genus *Spyridium*.

As in the case of *S. bifidum* some syntypes are labelled wrongly as coming from "Marble Ra." instead of "Boston Pt.". Some of these specimens are mounted together with a twig of *S. bifidum* and a corresponding label citing the wrong locality for that taxon. Clearly the labels have been mixed up.

***Etymology*:** From the Greek *stenos* (narrow) and *phyllon* (leaf), in reference to the species' long narrow leaves.

8a. *Spyridium stenophyllum* subsp. *stenophyllum*

Shrubs to 1.2 m high, resinous, especially on young stipules and bracts; young stems densely pubescent with white or grey long woolly stellate hairs, becoming matted when older. *Leaves* alternate: *stipules* triangular to narrowly ovate, 2.1–3.7 mm long, fused for more than half of their length, reddish-brown, glabrous, with hairs along midrib and cilia towards apex; *petiole* 0.9–1.6 (–2) mm long, glabrous, rarely with few hairs; *lamina* narrowly Y-shaped to narrowly cuneate, 4–7 (–8) mm long, 1.2–2.8 mm wide, base cuneate, margins revolute, apex deeply to shallowly emarginate or bilobed, each lobe of the Y-shaped leaf with a recurved mucro, upper surface green, glabrous, rarely with a few simple hairs between the two lobes, lower surface with dense to medium dense indumentum of white stellate hairs, mostly obscured by revolute margin, usually only midrib visible, midrib with long simple hairs. *Floral leaves* usually 3–5: broader than stem-leaves, 3.2–5 (–7) mm long, 1.6–2.3 mm wide, covered with a very dense, white felty stellate indumentums, interspersed with antrorse to spreading longer simple hairs. *Inflorescence* a globular head of cymosely arranged ± sessile flowers, 6–9 mm diameter; *bracts* in fused pairs, broadly ovate, 2–3 mm long, with long cilia, outer bracts with hairs along midrib. *Flowers* white to cream. *Hyponthium tube* 0.4–0.5 (–0.8) mm long, 1.4–1.5 mm diameter, base and most of tube densely pubescent with short stellate and overlying long hairs, often flexuous. *Sepals* 0.5–0.8 mm long, as long as hypanthium tube, with an indumentum of mainly short woolly simple or stellate hairs, especially towards tip; sepal:tube ratio 1:1. *Petals* 0.4–0.5 mm long, cucullate, clawed; limb:claw ratio *c.* 4–5:1. *Stomens* subequal to the petals, 0.3–0.5 mm long; *onthers* c. 0.2 mm long. *Ovary* inferior, carpels 2, summit with dense stellate hairs; *style* 0.6–0.7 mm long, minutely bilobed. *Infructescence* slightly expanding, but no tiled bracts visible. *Fruits* obovoid, 1.7–1.9 mm long, c. 1.3 mm wide, light brown, consisting of 1–2 papery fruitlets, torus apical, fruit wall densely pubescent; *seeds* flattened ovoid, 1–1.3 (–1.4) mm long, 0.8–1 mm wide, reddish brown with sparse black mottles or no mottles and a darkened red-brown base. Fig. 6i–m.

***Distribution & habitat*:** The typical subspecies is distributed around Arno Bay and along the east coast of Eyre Peninsula; scattered records are known from further inland, e.g. near Kimba and Caralue (Fig. 2). The taxon grows on sand.

***Phenology*:** Flowering in July–Oct, Jan.; fruits recorded in Aug., Sep., Jan.

***Notes*:** Leaves of the typical subspecies are usually narrower than in subsp. *renovatum*, and glabrous on the upper surface. A few intermediates are known from Hambidge Conservation Park, where the subspecies co-occur (*C.R. Alcock 1091*, AD 96709110; *R.L. Specht 2404*, AD 96108133). The typical subspecies also resembles *S. leucopogon*, which differs in having shorter and entire, not bilobed, leaves; this is a relationship that is under further investigation. Two specimens (*A.R.R. Higginson*

s.n. [*ACB 44120*]; *M.E. Phillips 167*) from near Kimba have a mixture of 2- and 3-locular ovaries and 2- and 3-fid styles.

***Conservation*:** Most collections of the taxon are older than 20 years. Recently, it has been recorded from Hambidge Conservation Park and near Iron Duke mine. More research on the current distribution and conservation status is needed. The subspecies should be listed as 'Data Deficient' (NPWC 2003) and be prioritised for a formal assessment.

Specimens examined: **SOUTH AUSTRALIA.** EYRE PENINSULA: W side of Iron Duke mining lease at Monitoring Site 6-RA, 18 Sep. 2003, *F.J. Bodman 11156* (AD); Above high water mark at N end of Boston Harbour, 200 m inland, 12 Jan. 1976, *B. Copley 4930* (AD, BR, HBG); Hundred of Rudall, adjoining Rudall township, 23 Oct. 1971, *Eyre Penins. Noture Conservotion Group 2* (AD); Arno Bay–Port Lincoln Rd, c. 7 miles from Arno Bay, 22 Sep. 1966, *J. Golbroith s.n.* (AD); Kimba, 1955, *A.R.R. Higginson* [*ACB 44120*] (MEL); 10 km NE of Cleve, scenic lookout, 21 Sep. 1988, *M. Hyde 252* (AD); Arno Bay, 29 Aug. 1935, *E.H. Ising s.n.* (AD); Hambidge C.P., Site: BS131-DAR00401, Patchid: 18197, 31 Oct. 2001, *S.D. Kenny & S.M. Corruthers BS13-688* (AD); Lincoln Hwy, c. 6 km NE of Arno Bay, 30 Dec. 1970, *A.E. Orchard 2988* (AD); Caralue, Sep. 1933, *Mrs Shuttleworth s.n.* (AD); Flora and Fauna Res., Hundred of Hambidge, 8 Nov. 1960, *R.L. Specht 2404 & 2431* (AD); Whyalla–Cowell Rd, c. 74 km S of Whyalla, 1 Oct. 1958, *P.G. Wilson 97* (AD); c. 5 km S of Murdinga, 31 Aug. 1976, *D.J.E. Whibley 5757* (AD); 25 miles from Kimba, towards Whyalla, 29 Aug. 1968, *M.E. Phillips 167* (CANB, MEL).

8b. *Spyridium stenophyllum* subsp. *renovatum* Kellermann & W.R.Barker, *subsp. nov.*

A subspecie typica foliis indumento superficialis pilis simplicis antrorsis et lamina parum latiore differt.

Holotypus: **SOUTH AUSTRALIA.** Track N of BBQ track, Telowie Gorge C.P., 7 Mar. 2008, *J. Kellermann 471, D. Duval & C. Brodie* (AD). *Isotypi:* B, BM, CANB, MEL, NSW, NY, PERTH, SI, US, W.

Illustrations: E.M. Canning in J.P. Jessop & H.R. Toelken, *Fl. S. Australia* 2: 816, fig. 429A (1986), as *S. bifidum* var. *bifidum*.

Shrubs 30–1.5 m high, resinous; young stems densely pubescent with white, light brown or grey short felted-tomentose stellate hars, sometimes also with longer simple hairs. *Leaves* alternate: *stipules* triangular to narrowly ovate, 2–3.8 (–6) mm long, fused for more than half of their length, reddish-brown, glabrous, with hairs along midrib and ciliate towards apex; *petiole* 1–2.2 mm long, glabrous to sparsely stellate pubescent; *lamina* narrowly Y-shaped to narrowly cuneate, (3.4–) 3.8–7.5 (–9.5) mm long, 1–2.8 mm wide, base obtuse to cuneate, margins revolute, apex deeply emarginate or bilobed (very rarely almost entire), each lobe of the Y-shaped leaf ± obtuse and hidden by a tuft of hairs, upper surface greyish-green, with a medium to dense silky indumentum of antrorse simple hairs, lower surface with dense to medium dense indumentum of grey-white stellate hairs, midrib also with long simple hairs. *Floral leaves* usually 3–5: broader than stem-leaves, 4.2–7 mm long, 2–3.8 mm wide, covered with a very dense, white felty stellate indumentum, often interspersed with longer simple hairs. *Inflorescence* a globular head of cymosely arranged ± sessile flowers, (6–) 7–11 (–12) mm diameter; *bracts* in fused pairs, broadly ovate, 2–3 mm long, with long cilia and hairs along midrib. *Flowers* white to cream. *Hypanthium tube* 0.4–0.5 mm long, (1.2–) 1.5–1.7 mm diameter, with sparse simple hairs or glabrous, base densely pubescent with short stellate and overlying long hairs, often flexuose. *Sepals* 0.7–1 mm long, as long as hypanthium tube, with an indumentum of mainly short simple or stellate hairs, especially towards tip; sepal:tube ratio 1:1. *Petals* 0.5–0.7 (–0.8) mm long, cucullate, long-clawed; limb:claw ratio *c.* 3:1. *Stamens* subequal to the petals, 0.4–0.6 mm long; *anthers* c. 0.2 mm long. *Ovary* inferior, carpels 2, summit with dense stellate hairs; *style* 0.6–0.8 (–1) mm long, minutely bilobed. *Infructescence* slightly expanding but no tiled bracts visible. *Fruits* ellipsoid, *c.* 2 mm long, c. 1.5 mm wide, light brown, consisting of 1 or 2 papery fruitlets, torus apical, fruit wall densely pubescent; *seeds* flattened obovoid, 1.3–1.4 mm long, *c.* 1 mm wide, light brown with dense to sparse black mottles and a darkened brown base. Fig. 6n–p, Fig. 8d.

***Distribution & habitat*:** This subspecies is mainly distributed in central and eastern Eyre Peninsula and the southern Flinders Ranges, west of Port Pirie, with a few isolated records from Burra Gorge on the east side of the southern Flinders Ranges, The taxon grows on sand-dunes and in mallee vegetation on sand, mainly over limestone, but some records also indicate shale, loam over quartzite and granite as substrates (Fig. 2).

***Phenology*:** Flowering in May–Nov.; fruits recorded in Sep.–Nov. and Jan.–Mar.

***Notes*:** The taxon is variable, e.g. in the density of the indumentum on the leaves and stems, and in the depth of lobing of the leaves. A few specimens from Eyre Peninsula and from the lower Flinders Ranges near Gladstone have leaves with an almost entire, emarginate apex (e.g. *Black 7*, MEL 233427; *James 114*, AD 96351166), not deeply Y-shaped as is usual for the species.

The species seems to form hybrids with *S. parvifolium* (specimens from Telowie Gorge and Napperby Gorge, e.g. *Bates 20478*, AD 98940201; *Spooner 6029*, AD 97919399), and possibly with *S. subochreatum* (F.Muell.) Reissek (*Udovicic 284*, CANB 480346). These specimens display intermediate characters, *e.g.* in the shape of the leaves and their venation (Fig. 6q).

***Conservation*:** The subspecies is widespread and not considered at risk.

***Etymology*:** The epithet *renovatum* is Latin, renewed, and refers to the former incorrect application of the name *S. bifidum* to this taxon. Its clarification has led to a renewed view of this taxon and the need for a new name.

***Selected specimens examined* (c. 170 seen): SOUTH AUSTRALIA.** GAIRDNER-TORRENS: Hills NW of Yarna, Gawler Ranges, 24 May 1983, *R.J. Bates 3146* (AD). EYRE PENINSULA: Hiltaba Station, c. 2 km W Hiltaba Homestead, 6 Sep. 1972, *B.J. Blaylock 1967* (AD); 37.7 km from Kimba toward Cleve, 5 Dec. 1982, *E.M. Canning 5482 & S. Corbett* (AD, CANB, HO, MEL, NSW); Road to Scow Ck from Wharminda, 18 Aug. 1978, *R.J. Chinnock 4305* (AD, MEL); Hincks C.P., c. 1 km along track which goes through centre of park from E boundary, top of first rise, 5 Jan 1996, *D.D. Cunningham 1247* (AD, CANB, MEL); 10.3–10.5 km W of Kimba on dune ridge, 7 Feb. 2006, *D.J. Duval 378 & T.E. Erickson* (AD); Along Eyre Hwy, c. 25 km WSW of Kimba (27 km by road), 4 Oct. 1967, *H. Eichler 19231* (AD, B, CANB, CBG); Darke Peak Ra., central portion, 28 Oct. 1983, *E.N.S. Jackson 4982* (AD, GZU, HO, MA, SYD); Sheoak Hill C.P., Site: BS128-HEG00S01, Patchid: 19169, 2 Dec. 2002, *R.S. Johnson & J.Schofield BS128 1245* (AD); 9 km N of Pondooma turnoff on Lincoln Hwy, 3 Nov. 1992, *T. Hall 427* (AD, CANB, MO); On Caralue Bluff summit, 60 m SSE from SE corner of fence around communication tower, Caralue Bluff CR, Site: BS128-CAR00101, Patchid: 19129, 28 Nov. 2002, *A.C. Robinson & J.T. Mcdonald BS128 1572* (AD); Track to Blue Ra. from Whaminda Soak, 6 Sep. 2006, *T.S. Te 16 & D.J. Duval* (AD, K); 14.4 miles [c. 23 km] N of Pt Neill, 12 Sep. 1970, *M.D. Tindale 471* (AD, K, NSW); Caralue Bluff, 29 Oct. 1983, *J.Z. Weber 8431* (AD, HO); Coolanie Ra., Mt Olinthus, 1 Oct. 1980, *D.J.E. Whibley 7264* (AD, CBG, MEL, ODU, OSH). NORTHERN LOFTY: Flinders Ra., near Gladstone, 9 Oct. 1909, *Anon. s.n.* (AD); Telowie Gorge area, 10 Oct. 1985, *R.J. Bates 6449* (AD); Upper eastern slope of The Bluff Ra. c. 11 km SW of Wirrabara and outside southern boundary of The Bluff Ra. Native Forest Res., 18 July 2002, *P.J. Lang BSOP 525*; Hills to N of Napperby Gorge, 30 Sep. 1978, *A.G. Spooner 6000*(AD); Top of ridge, Whitecliff Ra., Beetaloo Valley, 14 June 1980, *A.G. Spooner 6961* (AD). MURRAY: World's End, Burra Creek Gorge, 30 Jan. 1998, *D.E. Murfet 3131* (AD).

Taxon excluded from the *Spyridium bifidum* – *S. halmaturinum* complex

Spyridium coactilifolium var. *integrifolium* Benth., *Fl. Austral.* 1: 431 (1863).

= ***Spyridium thymifolium* Reissek, *Linnaea* 29: 289 (1858).** — *Trymalium stuartii* F.Muell. ex Reissek, *Linnaea* 29: 289 (1858), *nom. inval. pro syn*, as '*stuarti*'. — *Type citation*: 'Encounter Bay Nov. 1847 (Dr. F. Müller)'. *Holotype*: ?W. *Isotypes*: Encounter Bay, Nov. 1847, *C. Stuart s.n.* (MEL 2104786, labelled as "*Trymalium (Pomaderris?) Stuartii* Ferd.Mll."). *Possible isotype*: Encounter Bay, *s.dat., s.coll.* (K sheet with loan stamp H/1310/95 16/76, labelled as "*Pomaderris / Trymalium stuarti* F.Müller").

Spyridium stuartii Reissek & F.Muell., *Linnaea* 29: 289 (1858), as '*stuarti*'. — *Type citation*: 'Encounter Bay Nov. 1847 (Dr. F. Müller)'. *Lectotype (here designated)*: Encounter Bay, S.A., Nov. 1847, [*C. Stuart s.n.*] (MEL 2104271, labelled as "*Spyridium stuartii* Reiss. & Muell."). *Isolectotypes*: Encounter Bay, [S.A.,] *s.dat., C. Stuart s.n.* (MEL 2104272A, labelled as "*Spyridium Stuartii* F. Muell."); ?W.

Cryptandra obovata auct. non (Hook.) Hook.f.: Tate, *Handb. Fl. Extratrop. S. Austral.* 97 (1890), *pro parte*.

Reissek published *S. thymifolium* and *S. stuartii* simultaneously from material collected at Encounter Bay, listing under both taxa Mueller's manuscript name *Trymalium stuartii*. Reissek cited Mueller as the collector and Nov. 1847 as the collecting date. However, Mueller arrived in Australia on 18 Dec. 1847, after the collection date. The specimens were gathered by Charles Stuart, as is obvious from specimens at MEL and from the fact that Mueller named the species after the collector. Reissek distinguished the species by minor differences in indumentum and leaf size. Bentham first recognised that both names refer to the same variable species and subsumed both taxa under a variety of *S. coactilifolium*. Today the species is known as *S. thymifolium*. The name *S. stuartii* has not been used for the taxon since Bentham's time.

There are several specimens of Stuart's collection at MEL. Although *S. thymifolium* and *S. stuartii* were potentially described from the material collected by Stuart on the same day, we assume here that there is a type for each taxon. A collection labelled as "*Spyridium stuartii* Reiss. & Muell." by Mueller is selected as the lectotype of that species; a small twig labelled as "*Spyridium Stuartii* F.Muell." is most likely an isolectotype.

We regard another specimen, labelled by Mueller as being collected by Stuart and with the name "*Trymalium (Pomaderris?) Stuartii* Ferd.Mll. cl. Stuart leg." as an isotype of *S. thymifolium*, since here Mueller's manuscript name is mentioned on the label. Reissek worked in Vienna and the holotype of *S. thymifolium* should be sought at W. This choice of type also reflects slightly different leaf shapes indicated by Reissek and seen in the two specimens, with the isotype of *S. thymifolium* having almost round leaves and the lectotype of *S. stuartii* having ovate to elliptic leaves. A specimen at K is also labelled as "*Pomaderris / Trymalium stuarti* F.Müller" and a possible isotype, but it lacks details of the collector and date.

There is another quite deteriorated twig labelled as "Spyridium Stuartii Reiss & Müller" present on sheet MEL 2104272; however, this is not *S. thymifolium*, but possibly a small specimen of *S. fontis-woodii*, the label of which might have been mixed up with another collection.

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References

Barker, W.R. (1995). *Spyridium erymnocladum*, a new species from Eyre Peninsula, South Australia, and new stipule characters in Australian Rhamnaceae. *Journal of the Adelaide Botanic Gardens* **17**, 17–22.

Barker, W.R. (2005). 'Rhamnaceae', in W.R. Barker, R.M. Barker, J.P. Jessop and H. Vanaw (eds), *Census of South Australian vascular plants* pp. 90–91. Botanic Gardens of Adelaide & State Herbarium: Adelaide.

Barker, W.R. and Rye, B.L. (1993). *Spyridium tricolor* (Rhamnaceae), a disjunct new species from the Great Australian Bight. *Journal of the Adelaide Botanic Gardens* **15**, 153–157.

Bentham, G. (1863). 'Rhamneae', *Flora Australiensis, a description of plants of the Australian Territory* **1**, pp. 409–445. L. Reeve & Co.: London.

Biological Survey, South Australia (2004). *Flinders Chase National Park (NPWS): interim flora species list*. Department for Environment and Heritage, South Australia: Adelaide. http://www.environment.sa.gov.au/files/e4fad3b6-2f77-425d-b730-9e4f00b404e7/flinders_chase_np_family.pdf [accessed: 10 Mar. 2011].

Black, J.M. (1925). Additions to the flora of South Australia No. 23. *Transactions and Proceedings of the Royal Society of South Australia* **49**, 270–275.

Black, J.M. (1926). 'Rhamnaceae', *Flora of South Australia*, **3**, pp. 364–371. Government Printer, Adelaide.

Black, J.M. (1952). 'Rhamnaceae', *Flora of South Australia*, ed. 2, **3**, pp. 544–553. Government Printer, Adelaide.

Canning, E.M. (1986). '*Spyridium*', in J.P. Jessop and H.R. Toelken (eds), *Flora of South Australia* **2**, pp. 814–820. Government Printer, Adelaide.

Carter, O. and Downe, J. (2006). *National recovery plan for the forked spyridium Spyridium species 1 (Little Desert)*. Dept of Sustainability and Environment, Victoria: Melbourne.

D'Alton, S.E. (1913). Botany of the "Little Desert", Wimmera, Victoria. *Victorian Naturalist* **30**, 65–78 & pl. IV.

Geographical Names Unit (2000-). *Place names online: South Australian state gazetteer*. Government of South Australia, Land Services Group: Adelaide. http://www.placenames.sa.gov.au/ [accessed: 18 Aug. 2011].

Gerges, K.E. (1913). *Ausführliches lateinisch-deutsches Handwörterbuch, aus den Quellen zusammengetragen und mit besonderer Bezugnahme auf Synonymik und Antiquitäten unter Berücksichtigung der besten Hilfsmittel ausgearbeitet*. Hahnsche Buchhandlung: Hannover.

Jessop, J.P. (1989). A list of the vascular plants of South Australia (edition III). *Journal of the Adelaide Botanic Gardens* **12**, 1–163.

Kellermann, J. (2006a). *Cryptandra triplex* K.R.Thiele ex Kellermann, a new species of Rhamnaceae (Pomaderreae) from Arnhem Land, Northern Territory. *Austrobaileya* **7**, 299–303.

Kellermann, J. (2006b). New combinations for two species of *Spyridium* (Rhamnaceae: Pomaderreae) from the Grampians, Victoria. *Muelleria* **22**, 97–104.

Kellermann, J. (2006c). A range extension for *Cryptandra paganalaba* (Rhamnaceae: Pomaderreae) and recognition of a new subspecies. *Muelleria* **24**, 45–50.

Kellermann, J. (2007a). *The Australian stellate-haired Rhamnaceae: a systematic study of the tribe Pomaderreae*. The University of Melbourne: Parkville.

Kellermann, J. (2007b). Re-instatement of the name *Spyridium waterhousei* from Kangaroo Island, South Australia, with a short history of the tribe Pomaderreae (Rhamnaceae). *Journal of the Adelaide Botanic Gardens* **21**, 55–62.

Kellermann, J., Rye, B.L. and Thiele, K.R. (2006). *Palianthion*, a new genus of Rhamnaceae (Pomaderreae) from Western Australia and Queensland. *Australian Systematic Botany* **19**, 169–181.

Kellermann, J., Rye, B.L. and Thiele, K.R. (2008). Nomenclatural notes, typifications and name changes in *Trymalium* (Rhamnaceae: Pomaderreae). *Transactions of the Royal Society of South Australia* **132**, 18–28.

Kellermann, J. and Udovicic, F. (2008). Large indels obscure phylogeny in analysis of chloroplast DNA (*trn*L-F) sequence data: Pomaderreae (Rhamnaceae) revisited. *Telopea* **12**, 1–22.

Kellermann, J., Udovicic, F. and Ladiges, P.Y. (2005). Phylogenetic analysis and generic limits of the tribe Pomaderreae (Rhamnaceae) using internal transcribed spacer DNA sequences. *Taxon* **53**, 619–631.

Landbeater, M.M. (2006–). *Adelaide Co-operative History: Counties and Hundreds*. Family History South Australia, Barry Landbeater: Adelaide. http://www.ach.familyhistorysa.info/ [accessed: 18 Aug. 2011].

Lepschi, B.J., Monro, A.M., Kellermann, J., Thiele, K.R., Udovicic, F., Walsh, N.G., Rye, B.L., Bean, A.R. and APC Working Group (2011). *Australian Plant Census: Rhamnaceae*. Centre for Australian National Biodiversity Research & Council of Heads of Australasian Herbaria: Canberra. http://www.adelaide.edu.au/directory/juergen.kellermann [accessed: 18 Aug. 2011].

Mueller, F. (1855). *Definitions of rare or hitherto undescribed Australian plants*. Goadenough & Trembath: Melbourne.

Mueller, F. (1875). Rhamnaceae. *Fragmenta Phytographiae Australiae* **9**, 135–141.

Mueller, F. (1882). *Systematic Census of Australian Plants with Chronological, Literary, and Geographic Annotations. Part I. Vasculares*. M'Carron, Bird & Co.: Melbourne.

Mueller, F. (1886 [1885]). *Key to the system of Victorian plants. II. Enumeration of the native species, arranged under genera and orders, with annotations of their regional distribution, and with xylographic illustrations*. John Ferres: Melbourne.

Mueller, F. (1889). *Second systematic census of Australian plants, with chronological, literary and geographic annotations*. McCarron, Bird & Co.: Melbourne.

National Parks and Wildlife Council (NPWC) (2003). *2003 review of the status of threatened species in South Australia [discussion paper]*. Dept for Environment and Heritage, South Australia: Adelaide.

Reissek, S. (1858). Plantae Muellerianae: Rhamneae. *Linnaea* **29**, 266–96.

Richardson, J.E., Fay, M.F., Cronk, Q.C.B. and Chase, M.W. (2000). A revision of the tribal classification of Rhamnaceae. *Kew Bulletin* **55**, 311–340.

Rye, B.L. (1995a). New and priority taxa in the genera *Cryptandra* and *Stenanthemum* (Rhamnaceae) of Western Australia. *Nuytsia* **10**, 255–305.

Rye, B.L. (1995b). New and priority taxa in the genera *Spyridium* and *Trymalium* (Rhamnaceae) of Western Australia. *Nuytsia* **10**, 119–140.

Rye, B.L. (1996). A synopsis of the genera *Pomaderris*, *Siegfriedia*, *Spyridium* and *Trymalium* (Rhamnaceae) in Western Australia. *Nuytsia* **11**, 109–131.

Rye, B.L. (2008). New species and keys for *Cryptandra* and *Stenanthemum* (Rhamnaceae) in Western Australia. *Nuytsia* **16**, 325–382.

Tate, R. (1889a). A census of the indigenous flowering plants and vascular cryptogams of extra-tropical South Australia. *Transactions and Proceedings and Report of the Royal Society of South Australia* **12**, 67–128.

Tate, R. (1889b). Definitions of four new species of Australian plants. *Transactions and Proceedings and Report of the Royal Society of South Australia* **12**, 129–131.

Tate, R. (1889c). A revision of the flora of Kangaroo Island and other botanical notes relating thereto. *Transactions and Proceedings and Report of the Royal Society of South Australia* **12**, 62–66.

Tate, R. (1890). *A handbook of the flora of extratropical South Australia, containing the flowering plants and ferns*. Education Dept: Adelaide.

Thiele, K.R. (2007). Two new species of Australian Stenanthemum (Rhamnaceae), with a conspectus and key to species outside Western Australia. *Journal of the Adelaide Botanic Gardens* **21**, 67–74.

Thiele, K.R. and West, J.G. (2004). *Spyridium burragarang* (Rhamnaceae), a new species from New South Wales, with new combinations for *Spyridium buxifolium* and *Spyridium scortechinii*. *Telopea* **10**, 823–829.

Walsh, N.G. (1999). *'Spyridium'*, in N.G. Walsh and T.J. Entwisle (eds), *Flora of Victoria* **4**, pp. 115–120. Inkata Press, Port Melbourne.

Walsh, N.G. and Stajsic, V. (2007). *A census of the vascular plants of Victoria*. Royal Botanic Gardens Melbourne: South Yarra.

Weberbauer, A. (1895). 'Rhamnaceae', in H.G.A. Engler and K.A.E. Prantl (eds), *Die Natürlichen Pflanzenfamilien* **3(5)**, pp. 393–427. Wilhelm Engelmann: Leipzig.

Willis, J.H. (1973 [1972]). *A handbook to plants in Victoria* **2**. Melbourne University Press: Parkville.

Willson, A. and Bignall, J. (2008). *Draft regional recovery plan for threatened species and ecological communities of Adelaide and the Mount Lofty Ranges, South Australia*. Department for Environment & Heritage: Adelaide.

Herbarium collections – an invaluable resource for gall midge taxonomists

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Introduction

Leptospermum laevigatum (Gaertn.) F.Muell. (Myrtaceae), coast tea-tree is a bushy shrub native to coastal regions in south-eastern Australia (Lynn 1996). Following its use in dune stabilization programs and horticulture *L. laevigatum* became naturalized in some western Victorian coast and inland areas, Queensland, South Australia, Tasmania and Western Australia, where it is now considered a serious environmental weed (Burrell 1981; Lam & van Etten 2002; Adair *et al.* 2008). Dorchin and Adair (2010) described two new species of gall midge from the genus *Dasineura* (Diptera: Cecidomyiidae) inducing galls on *L. laevigatum* that cause severe malformation of buds, thereby preventing fruit set and seed formation. One species, *Dasineura tomentosa* Dorchin, induces galls broadly ovate-spherical in shape (Fig.1) formed by imbricate bracts that are tomentose-silky with appressed white hairs (Dorchin & Adair 2010). According to Dorchin and Adair (2010), *D. tomentosa* galls have been observed on *L. laevigatum* from northern New South Wales through to Nelson, Victoria, but it is likely to occur more extensively in eastern Australia.

Examination of herbarium specimens has previously been used for assessment of distribution of the gall midge *Rhopalomyia lawrenciae* Kolesik causing inflation of leaves of *Lawrencia squamata* Nees in Lehm. (Malvaceae) in South Australian saltmarshes (Kolesik 1998), *Asphondylia floriformis* Veenstra-Quah & Kolesik and *A. sarcocorniae* Veenstra-Quah & Kolesik infesting the beaded glasswort *Sarcocornia quinqueflora* (Bunge ex Ung.–Stern.) A.J. Scott (Veenstra-Quah *et al.* 2007), and *Asphondylia tecticorniae* Veenstra & Kolesik or *A. peelei* Veenstra & Kolesik on the shrubby glasswort *Tecticornia arbuscula* (R.Br.) K.A.Sheph. & Paul G.Wilson (Veenstra *et al.* 2011). Parasitoid wasps often attack cecidomyiids, for example *Asphondylia floriformis* and *A. tecticorniae* (Veenstra *et al.* 2011), and can be found in the galls caused by these gall midge species. Population densities of *D. tomentosa* are known to be regulated by parasitiod wasps (Dorchin & Adair 2010), by infecting and killing the developing gall midge larvae.

Herbarium collections of *L. laevigatum* were examined for the presence of *D. tomentosa* galls to find where this gall midge's occurrence has

Abstract

Dasineura tomentosa is a gall midge inducing distinctive galls on *Leptospermum laevigatum*. An efficient way of determining the geographic distribution of a gall midge is to examine herbarium specimens for the presence of galls inadvertently collected with the plant specimen. Of the 446 herbarium specimens of *L. laevigatum* examined 40 had galls caused by *D. tomentosa*, and two of the three galls examined in detail contained a parasitoid wasp. Despite some limitations, herbarium collections are an invaluable resource for insect taxonomists.

Keywords: Herbarium specimens, galls, gall midge, *Dasineura*

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Figure 1. Galls on *Leptospermum laevigatum* growing in Queenscliff, Victoria caused by the gall midge *Dosineuro tomentoso*. Mature galls 8 – 15 mm long and 7 – 12 mm wide. (Photo. Peter Kolesik).

inadvertently been recorded, and to determine whether there was any evidence of parasitoid wasp attack.

Materials & Methods

The geographic distribution of *D. tomentosa* was assessed by looking for their distinctive galls on specimens of *L. laevigatum* lodged in the National Herbarium of Victoria, (MEL) (n = 178), National Herbarium Canberra (CANB) (n = 123), Western Australian Herbarium (PERTH) (n = 62), and the State Herbarium of South Australia, Adelaide (AD) (n = 83). All herbarium specimens with galls present were annotated.

To investigate whether *D. tomentosa* had been attacked by parasitoid wasps, a single gall from three different *L. laevigatum* herbarium specimens (two were collected in the 1800s and the third in 1963) with a large number of galls present was carefully removed, dissected and photographed using an Olympus SZX16 stereo microscope with a digital camera.

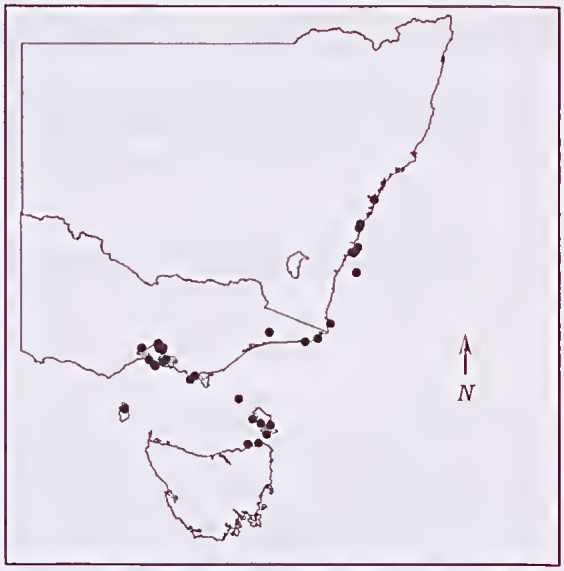

Figure 2. Distribution of *Dasineuro tomentosa* in southern Australia based on herbarium specimens of *Leptospermum laevigotum* with galls.

Results

Of the 446 specimens of *L. laevigatum* examined 40 had galls caused by *Dasineura tomentosa* – Adelaide (AD) (n = 1), Melbourne (MEL) (n = 20) and Canberra (CANB) (n = 19) (Table 1 and Fig. 2). The oldest plant specimen was collected from New South Wales by S. Johnson in 1875 (Fig. 3). As can be seen from dates of collections, gall formation is not a recently introduced phenomenon. The distribution of *Dasineura tomentosa* was described by Dorchin and Adair (2010) as being widespread in south eastern Australia, in coastal and near coastal habitats. This was similar to that ascertained using this method, with additional occurrences recorded from islands off the coast of Tasmania and Bowen Island off the coast of New South Wales.

The galls removed from herbarium specimens collected in1875 and 1963 both contained similar parasitiod wasps (Fig. 4). The third gall from a *L. laevigatum* specimen collected in 1887, contained *D. tomentosa* pupae still within the characteristic white silky cocoons formed on the outer bracts of the gall (Fig. 5).

Figure 3. Herbarium sheet (MEL2136272) with *Leptospermum laevigatum* specimen collected in East Gippsland by W.A. Sayer in 1887. Arrows indicate galls caused by the gall midge *Dasineura tomentosa*. Scale bar = 10 mm.

Table 1. Herbarium specimens of *Leptospermum laevigatum* with galls caused by *Dasineura tomentosa* held in Adelaide (AD) (n = 1), Melbourne (MEL) (n = 20) and Canberra (CAN8) (n = 19) with year of collection, collector and locality where specimens were collected.

Collection year	Collector	Locality	Herbarium ID
1875	S. Johnson	N.S.W.	MEL2136261
1882	E. Spong	King Island, Tasmania	MEL2137195
1882	C. alter	Port Phillip, Melbourne, Victoria	CANB398341
1884	Hon. Judge Dobson	Deal Island, Kents Group, Tasmania	MEL2136316
1885	D. McAlpine	8righton, Port Phillip, Victoria	MEL2136215
1887	W.A. Sayer	East Gippsland, Victoria	MEL2136272
1887	J. Minchin	Domain near 8otanic Museum, Melbourne, Victoria	MEL2136239
1930	H. Porter	Avalon, N.S.W.	CAN8395095
1949	C.W.E. Moore	Woollongong, N.S.W.	CANB24896
1949	J. Common	Jervis Bay, N.S.W.	CANB21615
1963	J.D.M. Pearson	Point Nepean, Victoria	MEL574903
1963	J.D.M. Pearson	Portsea, Victoria	MEL574905
1964	C.S. Rawlinson	Shoalhaven Heads, N.S.W.	CANB24176
1966	E.J. Carroll	8alnarring, Victoria	CAN815951
1966	E.J. Carroll	Cape Schanck, Victoria	CAN815952
1968	R.Pullen	South of Kiama, N.S.W.	CAN8314280
1969	C. Dunlop	Cape Liptrap, Victoria	CAN852159
1970	I. 8eeton	Portsea, Victoria	CAN839729
1971	N.E. Phillips	Waratah Bay, Victoria	MEL2136307
1971	M.E. Phillips	Waratah Bay, Victoria	CANB56527
1975	W.M. Curtis	Trousers Point, Flinders Island, Tasmania	MEL598207
1975	J.S. Whinray	Big Bog Island, Furneaux Group, Tasmania	CANB480995
1976	J.S. Whinray	Clarkes Island, Furneaux Group, Tasmania	MEL530296
1976	J. Piggin	Long Island Point, Victoria	CAN8610348
1979	M. Kenny	Edithvale, Victoria	AD97909172
1980	J. Taylor	Bowen Island, N.S.W.	CAN88008284
1980	R. Hart	Jervis 8ay, N.S.W.	CANB8005705
1983	A. Moscal	Petal Point, Tasmania	MEL104939
1985	G. Lucas	East Gippsland, Victoria	MEL684468
1987	Unknown	Clayton South, Victoria	MEL2016753
1991	A. M. Lyne	Lobster Bay, N.S.W.	CAN89105002
1991	D. E. Albrecht	Croajiingolong National Park, East Gippsland, Victoria	CANB9217301
1995	R. P. Cameron	Lower Snowy River, N.S.W.	MEL2136302
1998	A. J. Whalen, G. T. Chandler & S. Fethers	8en 8oyd National Park, N.S.W.	CANB9909907
2002	S. Harris	Waterhouse Island, Tasmania	MEL2203854
2002	S. Harris & A. Connolly	Waterhouse Island, Tasmania	MEL2203852
1960s	J.S. Whinray	Sealion Island, Furneaux Group. Tasmania	MEL2112101
1960s	J.S. Whinray	Penguin Island, Tasmania	CANB554972
ND	T.E. George	8lack Rock, Victoria	MEL2030715
ND	Unknown	Little River, Victoria	MEL2137197

Discussion

The reliability of this method for determining geographic distribution has obvious limitations in that the absence of galls on herbarium specimens does not necessarily mean that there were no gall midges at a particular location. Firstly, because the time of collection may preclude the presence of galls, and secondly, the plant material chosen by a collector may not include 'abnormal' growths. The specimens selected and the way in which some herbarium specimens were mounted by some early collectors e.g. S. Johnson in 1875 (Fig. 3) suggest that the collector may have mistaken the *D. tomentosa* galls for *L. laevigatum* flower buds. In fact one twentieth century collector selected a *L. laevigatum* specimen with many galls and commented on the 'large flowers' while another noted that the flowers on the specimen were 'abnormal'.

Despite these limitations, herbarium collections do provide information that is invaluable for both botanists and gall midge taxonomists. In addition to determining a gall midge's geographic distribution over time, sites for collection of specimens for taxonomic purposes can

Figure 4. Galls caused by *Dasineura tomentosa* removed from herbarium specimens of *Leptospermum laevigatum* collected in1875 and 1963 both contained similar parasitiod wasps.

Figure 5. A dissected gall from a *Leptospermum laevigatum* specimen collected in 1887, with *D. tomentosa* pupa (indicated by arrow) still within the characteristic white silky cocoons formed on the outer bracts of the gall.

be ascertained if the collector has recorded the month a plant specimen was collected. In the case of cecidomyiid gall midges, their parasitoid predators may also be present in galls on herbarium specimens, in sufficiently good condition for hymenopteran taxonomists to be able to positively identify them to species level. It would therefore be useful to encourage the collection of both 'typical' and 'aberrant' plant material for inclusion as herbarium vouchers.

Acknowledgements

I would like to acknowledge the directors and staff of AD, CANB, MEL, and PERTH, for kindly allowing access to herbarium collections, and Alison Vaughan (Royal Botanic Gardens Melbourne) for her expertise.

References

Adair, R., Cheal, D. and White, M. (2008). Advisory list of environmental weeds in coastal plains and heathy forest bioregions of Victoria. (Accessed 10 January 2012) http://www.dse.vic.gov.au/

Burrell J.P (1981). Invasion of Coastal Heaths of Victoria by *Leptospermum laevigotum* (Gaertn.) *F.* Muell. *Australian Journal of Botony.* **29**(6), 747-764.

Dorchin, N. and Adair, A.J. (2010) Two new *Dasineuro* species (Diptera: Cecidomyiidae) from coastal tea tree, *Leptospermum laevigotum* (Myrtaceae) in Australia. *Australian Journal of Entomology.* **50**, 65-71.

Kolesik P. 1998. *Rhopalomyia lawrencioe*, a new gall midge species (Diptera: Cecidomyiidae) deforming leaves of *Lawrencia squamata*(Malvaceae) in South Australia. *Transactions of the Royal Society of South Australia.* **122**, 139–145.

Lam, A. and van Etten, E. (2002). Invasion of indigenous vegetation in south-western Australia by *Leptospermum laevigotum* (Myrtaceae). In: *13th Australian Weeds Conference proceedings: Weeds 'Threats now and forever'* (editors H. Spafford, Jacob, J. Dodd and J.H. Moore). Plant Protection Society of W.A. Perth.

Lynne, A (1996). *'Leptospermum'*, in N.G. Walsh and T.J. Entwisle (eds), *Flora of Victoria* 3, pp1009-1020. Inkata Press: Melbourne.

Veenstra-Quah AA, Milne J and Kolesik P. 2007. Taxonomy and biology of two new species of gall midge (Diptera: Cecidomyiidae) infesting *Sarcocornia quinqueflora* (Chenopodiaceae) in Australian salt marshes. *Australian Journal of Entomolog.* **46**, 198–206.

Veenstra, A.A., Michalczyk, A. and Kolesik, P. (2011). Taxonomy of two new species of gall midge (Diptera: Cecidomyiidae) infesting *Tecticornia arbuscula* (Salicornioideae: Chenopodiaceae) in Australian saltmarshes. *Australian Journal of Entomology.* **50**, 393–404.

Analysis of genetic variation in a disjunct, narcotic producing, population of *Duboisia hopwoodii* (F. Muell.) F. Muell.

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Introduction

The native Australian narcotic 'Pituri' was used by Aboriginal people of western Queensland as a social lubricant and an enhancer of endurance and strength. At the time of European settlement the trade of Pituri was extensive, covering an area of 550 000 square kilometres (Watson 1983). Pituri is obtained from the leaves and small twigs of the plant *Duboisia hopwoodii* (F. Muell.) F. Muell., family Solanaceae (Figure 1). The leaves were dried and mixed with ash to make a quid for chewing (Keogh 2011). H. Beckler, who tried the drug on the Burke and Wills expedition in 1861, described it as producing "a dreamy voluptuous sensation" (Roth 1897:31). By coincidence, Beckler collected the type specimen of *D. hopwoodii* on this same expedition, unaware that it was the source of the drug Pituri. *Duboisia hopwoodii* is an arborescent shrub which grows to 3 m tall and occurs across the arid zone of Australia (Maiden 1893). However the most highly sought after form of this potent drug has been obtained from an isolated population in the north east of the Simpson Desert in the Mulligan River region (Figure 2). The plants in this area produce higher levels of the narcotic nicotine and lower levels of the highly toxic substance D-nor-nicotine relative to plants occurring in other areas (Barnard 1952). The exact location of this unique population was once a closely guarded secret passed between male Aboriginal elders who presided over the harvest, artificial drying of the leaves and burning off of plants to increase yield. Claims by people familiar with the plants of this area that they do not produce fruit has sparked a hypothesis that the population contains only one or a few clones of ancestral individuals that have spread vegetatively and are largely, if not entirely, self-incompatible or sterile. If this population of *D. hopwoodii* were clonal, this would offer an explanation for the unique chemical properties of its leaves.

Abstract

The most highly sought after source of the native drug Pituri is a single population of *Duboisia hopwoodii* in south-western Queensland, near the Mulligan River. Inter-simple sequence repeats and sequence-related amplified polymorphisms were used to determine the genetic variation between 25 individuals from the Mulligan River population and a morphometric study investigated whether it is morphologically, as well as chemically, distinct. Results showed high genetic variability, refuting a hypothesis that the population contains only a few clones. However, two potential clones were identified from the genetic analysis, having only a small number of differences that could be explained by somatic mutations. The morphology of the Mulligan River population was found to be within the typical range for the variable *D. hopwoodii*.

Keywords: clonality, nicotine, Pituri, Solanaceae, ISSRs, SRAPs

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Figure 1. *Duboisia hopwoodii* plant from the study area (photo: N. Walsh)

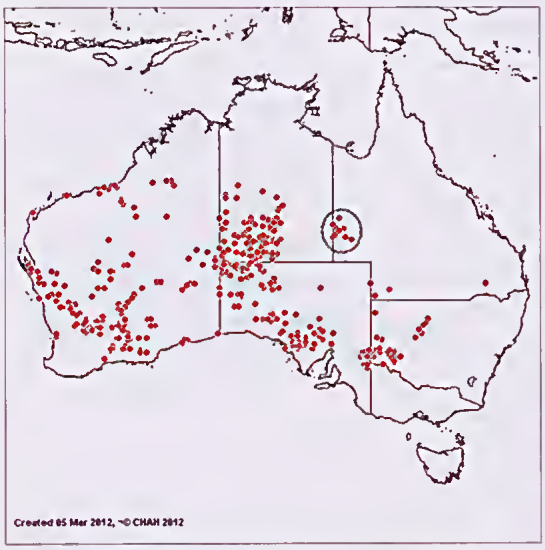

Figure 2. Distribution of *D. hopwoodii* with Mulligan River Region circled

Materials and methods

Genetic analysis

Leaf material was collected from 25 plants growing in Ethabuka Reserve, in the Mulligan River region, in the north-west of the Simpson Desert, in July 2010 (Figure 3a, b). Samples were taken along a transect about 20 km long (Figure 4). Samples were dried separately in paper bags placed in silica gel. DNA was isolated from 20-25mg of dried material using the QIAGEN plant DNeasy plant minikit. The manufacturer's protocol was followed except that leaf material was ground in a mortar and pestle with a small amount of sand.

As there is no genomic information available on *D. hopwoodii*, inter-simple sequence repeats (ISSRs) and sequence-related amplified polymorphisms (SRAPs) were used. These methods require no prior knowledge of the genome and have been successfully used on other members of the family Solanaceae (Li *et al.* 2010; Isshiki

Figure 3 a,b. Packing up plant presses, ready for the new day's collecting. (photo: N. Walsh)

et al. 2008; Kochieva *et al.* 2002). ISSRs have also been used for the identification of clones in many different taxa and for distinguishing between individuals in taxa where genetic variation may be limited (James and McDougall 2007; Li-Wang *et al.* 2008).

Nineteen ISSR and SRAP primer sequences (Li *et al.* 2010; Isshiki *et al.* 2008; Kochieva *et al.* 2002) were obtained from Invitrogen Australia and screened for consistent amplification of *D. hopwoodii* DNA fragments. Four primers were promising (UBC 888, FC8, M9 and M14; Table 1) and were used to amplify all samples.

Polymerase chain reactions (PCR) took place in 10µL reactions containing 5µL HotStarTaq Master Mix, 0.5 µL primer, 1µL DNA (20 – 40 ng) and 3.5µL H_2O. DNA amplification was performed in an Eppendorf MasterCycler gradient thermal cycler (Eppendorf, Hamburg, Germany). Annealing temperatures and ISSR cycles were based on the papers in which the primers were published or determined from a gradient PCR. PCR profiles for each primer are given in Table 2.

Table 1. Primers and sequences

Primer	Sequence 5'-3'
U8C 888	BDB(CA) 7
M9	(GACAC) 4
M14	(GACA) 4
FC8	GTGCTTTACTGTTTGCTCC

PCR products (10 µL) mixed with 2 µL of 6x loading dye were loaded into 2% agarose gel stained with ethidium bromide in 1xTBE (Tris-borate EDTA) buffer and run at 70 volts for between 2 and 4 hours depending on the size of the gel. DNA was visualised under UV light and scored

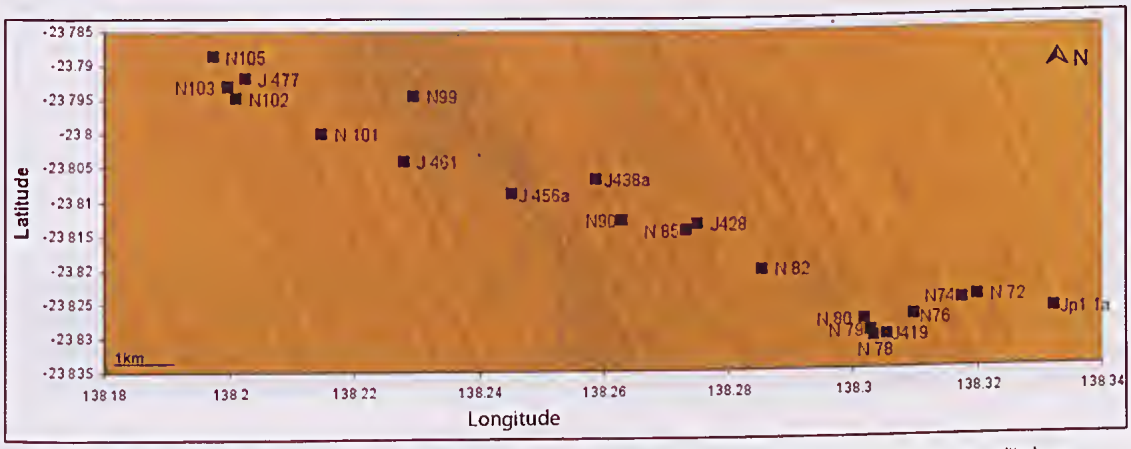

Figure 4. Satellite image of the study area showing orientation of sand dunes and the location of *D. hopwoodii* plants sampled for genetic analysis

Table 2. PCR protocols for each ISSR and SRAP primer used to amplify all samples *not used in final analysis

Primer	PCR protocols					
	Initial denaturation	Denaturation	Annealing	Elongation	PCR cycles	Final elongation
M14	15 min @ 95°C	30 sec @ 94°C	30 sec @ 42°C	30 sec @72°C	45	10 min @ 72°C
M9*	15 min @ 95°C	30 sec @ 94°C	30 sec @ 48°C	30 sec @72°C	45	10 min @ 72°C
U8C888	15 min @ 95°C	30 sec @ 94°C	30 sec @ 58°C	30 sec @72°C	45	10 min @ 72°C
FC8	15 min @ 95°C	30 sec @ 94°C	30 sec @ 35°C	30 sec @72°C	8	10 min @ 72°C
		+ 30 sec @ 94°C	30 sec @ 50°C	30 sec @72°C	32	

using Kodak Molecular Imaging Software (Eastman Kodak Company 2005). Each sample was repeated a minimum of two times to ensure repeatability of bands.

For each individual, the presence or absence of each DNA fragment was scored as "1" or "0", respectively. Bands that did not replicate consistently were not scored. Polymorphic bands from all useful primers were combined to generate one binary data matrix. One monomorphic band was removed from data before analysis. GenAlEx version 6.4 (Peakall and Smouse 2006) was used to perform a Mantel test, a Spatial Structure Analysis, a Matching Multilocus Analysis and an Allele Frequency Test. A Principal Co-ordinate Analysis (PCA; distance without data standardisation) was also performed from the genetic distance matrix and the geographic distance matrix using PATN version 3.03 (Belbin and Collins 2004).

Morphometrics

Herbarium specimens of *D. hopwoodii* from Western Australia, South Australia, the Northern Territory, New South Wales and Queensland were examined for morphological differences. Thirty-two specimens were measured for leaf length : width ratio, corolla length, inflorescence length, pedicel length, peduncle length, leaf shape and inflorescence branching pattern. The data generated were analysed with a multivariate analysis using NTSYSpc Version 2.11 (Rohlf 2000). Data for each character were range-standardised, such that the range of all characters equaled 1 unit, giving all characters equal weight (recommended by Milligan and Cooper 1988). Pairwise distances between specimens were calculated using the Manhattan metric, and the distance matrix subjected to clustering by the unweighted pair-group using arithmetic averages method (UPGMA; Sneath and Sokal 1973), and ordination using Non-metric Multidimensional Scaling (NMDS; Kruskal 1964a, b) in three dimensions. Specimens from Ethabuka reserve were also inspected for mature fruits.

Results

Genetics

Four primers (UBC 888, FC8, M9 and M14) amplified well with a high level of consistency across replicate pcr runs (Figure 5). M9 produced many bands too close together to score accurately so the locus was not included in further analysis. Each primer produced between 7 and 14 reliable bands giving a total of 33 bands, 32 of which were polymorphic (96.96%). The size of scored bands ranged from 330bp to 1300bp.

Twenty-five distinct genotypes could be recognised in the multilocus analysis. The lowest numbers of

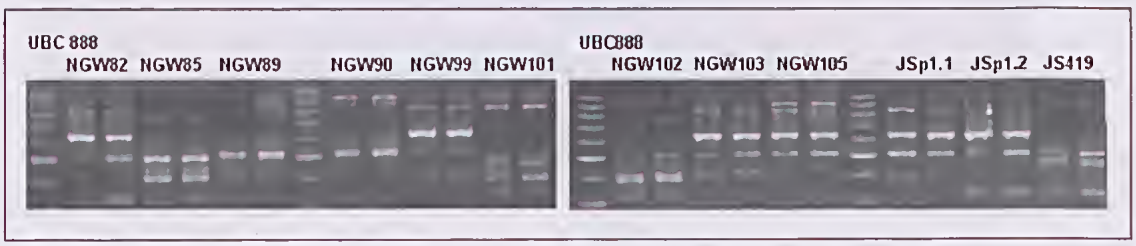

Figure 5. Replicates of samples 82 to 419 with primer U8C 888 showing consistency of bands and presence of polymorphisms. Unlabelled lanes contain Promega 100bp molecular size marker

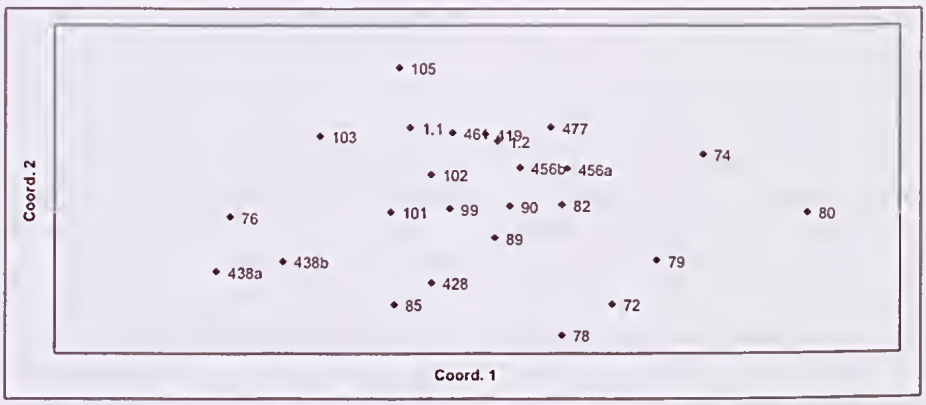

Figure 6. Principal Co-ordinate Analysis of genetic data via distance matrix without standardisation

different bands between two samples were 1 and 2 between two sets of adjacent plants; JS4S6a and JS456b were not more than 30 m apart whereas NGW85 and JS428 were located roughly 225 m apart. The maximum number of differences was 21 between NGW74 and JS438a, and NGW80 and JS438a. The PCA did not reveal any significant groupings of genotypes (Figure 6). The Spatial Structure Analysis did not find any correlation between geographic distance and genetic distance of samples, a finding which was supported by a Mantel Test (R^2=0.0007, P=0.381).

Morphometrics

The specimen from Ethabuka was not shown to be morphologically distinct from the other specimens examined, having a central position in the multidimensional ordination (Figure 7). In the UPGMA dendrogram the specimen from Ethabuka was grouped with other specimens from Queensland as well as specimens from New South Wales, the Northern Territory and South Australia. No fruiting specimens were found from the Mulligan River or Ethabuka regions.

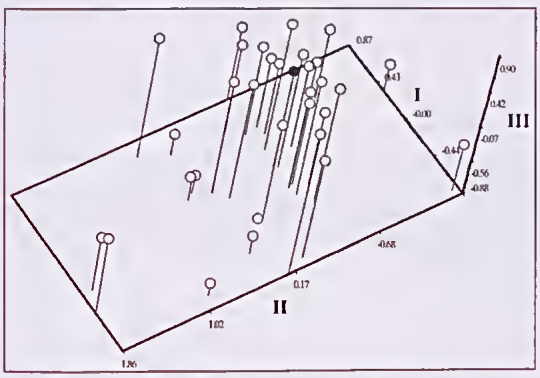

Figure 7. Spatial ordination of morphological characters. Specimen from Ethabuka Reserve black. Stress value = 0.097

Discussion

The brief morphological study undertaken did not find any morphological distinction between the population from Ethabuka and other populations across Australia that might suggest taxonomic distinctness to support the chemical uniqueness of this population. Nonetheless, considerable variation was seen within the species and it is possible that a more comprehensive study may detect morphological groupings across the entire species' range.

The genetic analysis has dispelled the hypothesis that the Ethabuka population contained only one or a few clones by finding 25 distinct genotypes from 25 samples. Therefore, the specimens sampled were established by seed and have since persisted vegetatively. However, JS456a and JS456b; and NGW8S and JS428, have only 1 and 2 differences respectively out of 32 bands, and could potentially be clone-mates with differences due to accumulated somatic mutations. As described by the genetic mosaicism hypothesis (Whitham and Slobodchikoff 1981), long-lived plants may accumulate somatic mutations in their individual "modules". The competition between modules of the same plant and consequential "natural pruning" of inferior modules are evolutionary pressures which result in a gradual change in genetic composition of the plant, creating a chimera. In this way, with somatic mutations as a source of

variation, perennial plants are able to evolve on a faster scale than the life span of a genet. The rate of somatic mutations has been predicted to be very low and unlikely to be detected (Gill *et al.* 1995) but Gross *et al.* (2012) clearly demonstrated somatic variation in ISSRs used to characterise clones of *Grevillea rhizomatosa* (Proteaceae). The likelihood of detection is predicted to increase with age of clones as well as the rate of somatic mutations. Examples of somatic mutation have been published for other plant species such as grape varieties that have been propagated clonally for more than 200 years (Crespan 2004; Hocquigny *et al.* 2004) and long-lived trees. Although the mutability of *D. hopwoodii* is unknown, the potato *Solanum tuberosum* L., also a member of the Solanaceae, has been shown to have high levels of somatic variability (Whitham and Slobodchikoff 1981). The age of the clones is also unknown but the distance between NGW85 and JS428 (225 m) suggests that they are quite old. These putative clones could be evidence for asexual reproduction occurring in the Ethabuka population and set the minimum potential for vegetative spread at 225 m. With more intensive sampling the maximum size of a clone could be determined.

Fire frequency is known to influence reproductive mode in plant species. Following destruction of the above-ground biomass of *G. rhizomatosa*, re-sprouting plants took 8 years to commence flowering (Gross *et al.* 2012). Pituri plants were burnt frequently by Aboriginal people to encourage new growth. It is possible that the burning regime has favoured plants that reproduce vegetatively over those that only reproduce via seed, resulting in the elimination of plants that rely solely on seed production. However, information is lacking on whether the extant clones are restricted to vegetative reproduction due to sterility.

The singularity of the Mulligan River population of *D. hopwoodii* could be investigated further through genetic analysis of typical, non-disjunct populations from Central and Western Australia. Although the Ethabuka population was found to be genetically diverse, a comparison with other populations could determine its relationship and an indication of its origin.

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References

Barnard, C. (1952) The Dubaisias af Australia. *Economic Botony* **6,** 3-17.

Belbin, L. and Collins, A. (2004). PATN version 3.02 and 3.03. Blatant Fabricatians Pty Ltd., Habart, Tasmania.

Crespan, M. (2004). Evidence an the evalution of palymorphism of microsatellite markers in varieties of *Vitis vinifero* L. *Theoreticol ond Applied Genetics* **108,** 231-237.

Gill, D.E., Chao, L., Perkins, S.L. and Wolf, J.B. (1995). Genetic Masaicism in Plants and Clonal Animals. *Annual Rewiew of Ecalogy and Systematics* **26,** 432-444.

Grass, C.L., Nelsan, P.A., Haddadchi, A. and Fatemi, M. (2012). Samatic mutatians contribute ta genotypic diversity in sterile and fertile papulatians af the threatened shrub, *Grevillea rhizamatosa* (Prateaceae). *Annols af Batony* **109,** 331-42.

Hocquigny, S., Pelsy, F., Dumas, V., Kindt, S., Heloir, M.C. and Merdinoglu, D. (2004). Diversification within grapevine cultivars gaes thraugh chimeric states. *Gename* **47,** 579-589.

Isshiki, S., Iwata, N. and Khan, M.M.R. (2008). ISSR variatian in eggplant (*Salonum melangena* L.) and related *Solonum* species. *Scientia Harticulturae* **117,** 186-190.

James, E.A. and McDougall, K.L. (2007). Extent af clonality, genetic diversity and decline in the endangered mallee *Eucolyptus imlayensis*. *Austrolion Journol af Batony* **55,** 548-553.

Keogh, L. (2011). Duboisia Pituri: A Natural History *Historical Records af Austrolian Science* **22,** 119-214.

Kochieva, E.Z., Ryzhava, N.N., Khrapalava, I.A. and Pukhalskyi, V.A. (2002). Using RAPD for Estimating Genetic Palymorphism in and Phylogenetic Relatianships amang Species af the Genus Lycopersicon (Tourn.) Mill. *Russion Journol of Genetics* **38,** 958-966.

Kruskal, J.B. (1964)a. Multidimensional scaling by optimizing goodness of fit to a nonmetric hypothesis. *Psychometrika* **29**, 1-27.

Kruskal, J.B. (1964)b. Nonmetric multidimensional scaling: a numerical method. *Psychometrika* **29**, 28–42.

Li, H., Chen, H., Zhuang, T. and Chen, J. (2010). Analysis of genetic variation in eggplant and related *Solanum* species using sequence-related amplified polymorphism markers. *Scientia Horticulturae* **125**, 19-24.

Li-Wang, L., Li-Ping, Z., Yi-Qin, G., Ming-Xia, W., Li-Ming, C., Jin-Lan, Y., Yan, W., Fan-Min, Y. and Long-Zhi, W. (2008). DNA fingerprinting and genetic diversity analysis of late-bolting radish cultivars with RAPD, ISSR and SRAP markers. *Scientia Horticulturae* **116**, 240-247.

Maiden, J H. (1893). The useful native plants of Australia. Trubner & Co: London.

Milligan, G.W. and Cooper, M.C. (1988). A study of standardisation of variables in cluster analyses. *Journal of Classification* **5**, 181-204.

Peakall, R. and Smouse, P.E. (2006) GenAlEx (version 6.4). Australian National University: Canberra.

Rohlf, FJ (2000). NTSYS-pc numerical taxonomy and multivariate analysis system (version 2.11T). Exeter Software: Setauket.

Roth, W.E. (1897). Ethnological studies among the north-west-central Queensland Aborigines. Government Printer: Brisbane.

Sneath, P.H.A. and Sokal, R.R. (1973). 'Numerical taxonomy: the principles and practice of numerical classification.' Freeman and Company: San Francisco.

Watson, P. (1983). This precious foliage: A study of the Aboriginal psychoactive drug Pituri. Sydney: *Oceania Monographs* Issue 26.

Whitham, T.G. and Slobodchikoff, C.N. (1981). Evolution by individuals, Plant-Herbivore Interactions, and Mosaics of Genetic Variability: The Adaptive Significance of Somatic Mutations in Plants. *Oecologia* **49**, 287-292.

Illustration, distribution and cultivation of *Lachnagrostis robusta, L. billardierei* and *L. punicea* (Poaceae)

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Abstract

Illustrations are presented for *Lachnogrostis robusto, L. billardierei* subsp. *billardierei, L. billordierei* subsp. *tenuiseta, L. puniceo* subsp. *puniceo* and *L. puniceo* subsp. *filifolio* as a supplement to an earlier paper (Brown and Walsh 2000) which provided a taxonomic revision of these grasses. Distributions of a number of these taxa within South Australia and Victoria are updated and the results of morphological and phenological observations under nursery conditions are reported.

Keywords: morphology, phenology, taxonomy, grasses

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Introduction

Brown and Walsh (2000) published new combinations for some varieties of *Agrostis billardierei* R.Br. and *A. aemula* R.Br.: *A. billardierei* var. *robusta* Vickery as *A. robusta* (Vickery) A.J.Br. & N.G.Walsh, *A. billardierei* var. *filifolia* Vickery as *Agrostis punicea* A.J.Br. & N.G.Walsh var. *filifolia* (Vickery) A.J.Br. & N.G.Walsh, *A. billardierei* var. *collicola* D.I.Morris as *A. collicola* (D.I.Morris) A.J.Br. & N.G.Walsh and *A. aemula* var. *setifolia* Vickery as *A. punicea* var. *punicea*. Subsequently, Jacobs (2001, 2002, 2004) transferred these and other related taxa to *Lachnagrostis* Trin. and raised the rank of varieties to subspecies, thus: *L. robusta* (Vickery) S.W.L.Jacobs, *L. billardierei* (R.Br.) Trin. subsp. *billardierei, L. billardierei* subsp. *tenuiseta* (D.Morris) S.W.L.Jacobs, *L. collicola* (D.Morris) S.W.L.Jacobs, *L. punicea* (A.J.Br. & N.G.Walsh) S.W.L.Jacobs subsp. *punicea* and *L. punicea* subsp. *filifolia* (Vickery) S.W.L.Jacobs.

Since that time, further field work has discovered new populations of some of these taxa in South Australia and Victoria, which either consolidates or extends their distribution.

Some taxa have also been subjected to cultivation under potted nursery conditions, to observe growth habit and flowering patterns and to examine whether any further taxonomic differentiation is warranted. This paper reports on these studies and uses the opportunity to illustrate the taxa, which was not undertaken in the original paper.

Methods

Field survey

Information was collated on additional populations of the study taxa, which had been discovered in the field or redetermined from previously collected herbarium material, in the 12 years since the original paper was published.

Pot trials

Seed harvested during 1996–99 from five Victorian populations of *Lachnagrostis robusta* (Table 1) was sown into seedling mix (potting

mix, sand and perlite) on 26 September 2001 under glasshouse nursery conditions. Eight seedlings per accession at 3- or 4-leaf stage, were transferred on 21 November 2001 to 15 cm diam. pots containing a slow-release fertilised, pinebark based, potting mix and grown on for two seasons on outdoor benches on a lawn at the Department of Primary Industries Werribee Centre. Water was applied as required, with an overhead sprinkler. Measurements of overall plant height (vertical height), maximum leaf width, leaf condition (inrolled, folded or flat) and inflorescence number were made periodically throughout the growing season. At the start of the second season, two year old plants of *L. billardierei* subsp. *billardierei*, *L. billardierei* subsp. *tenuiseta*, *L. punicea* subsp. *punicea* and *L. punicea* subsp. *filifolia* (Table 1) that had survived (1-4 plants per accession) from a previous pot trial were repotted and added to the outdoor trial, for which the onset of flowering and inflorescence numbers were recorded.

Further seed harvests during 2008–10 (Table 1) provided seedlings for use in growth observation trials over the 2010–11 and 2011–12 growing seasons at the Royal Botanic Gardens Melbourne Nursery. In the first trial, glasshouse raised seedlings were transferred to 10 cm diam. pots and repotted to a slow-release fertilised, pinebark based mix in 15 cm diam. pots for observation during October-February 2010–11. Four plants from one accession per taxon were selected for assessment. Plants were kept in a shade-house with one automatic watering per day in the cooler months and two waterings per day in the warmer months. Measurements of overall plant height, maximum length (i.e. longest plant extension in any direction), maximum leaf width and leaf condition were made prior flowering. The second trial was similar to the first, except that seedlings were transferred directly into 15 cm diam. pots and placed on a low, steel open-mesh grill over an outdoor, concrete pad and automatically watered on a daily basis. For this trial, only one plant per accession was grown but multiple accessions per taxon were represented for *L. billardierei* subsp. *billardierei*, *L. punicea* subsp. *punicea* and *L. robusta*.

Results

Field survey

Lachnagrostis robusta

Many new populations of this species were found in the more saline waterways of inland sites in South Australia. In addition, its known distribution is now extended into Kangaroo Island and Yorke Peninsula. An old collection of *L. filiformis* (G.Forst.) Trin. was also redetermined as *L. robusta* from the Eyre Peninsula. A few collections were also made from saline lake flats in the southern Wimmera district of Victoria; thereby extending its known distribution northward in that State. Fig 1a-e.

Table 1. Vouchers for accessions of *Lochnogrostis* taxa used in nursery observation trials.

Taxon	Trial Period	Vouchers
L. robusta	2001-03	Salt Swamp, Vic., *A.J.Brown 1225* (MEL); Willaura, Vic., *A.J.Brown 1102* (MEL); Lake Linlithgow, Vic., *A.J.Brown 2525* (MEL); Skipton, Vic., *A.J.Brown, 863* (MEL); Carranballac, Vic., *A.J.Brown, 14B3* (MEL)
	2011-12	Carranballac, Vic., *A.J.Brown 14B3* (MEL); Telfers Swamp, Vic., *A.J.Brown 2336* (MEL); Holm Hill, SA, *R.J.Botes B0B01* (MEL); Lenunga, SA, *R.J.Bates 75793* (MEL)
L. billardierei* subsp. *billardierei	2002-03	Swan Bay, Vic., *A.J.Brown 1469* (MEL); Walkerville, Vic., *A.J.Brown 1554* (MEL); St Marnocks, Vic., *A.J.Brown 111B* (MEL)
	2010-12	St Marnocks, Vic., *A.J.Brown 111B* (MEL); Tilley Swamp, SA, *A.J.Brown 1606* (MEL); Reedy Creek, SA, *R.J.Bates 757B6* (MEL); Piccaninnie Ponds, SA, *A.J.Brown 1739* (MEL); Mitre Lake, Vic., *A.J.Brown 2327* (MEL); Emita Beach, Tas., *A.J.Brown 24B0* (MEL)
L. billardierei* subsp. *tenuiseta	2002-03	Dolphin Sands, Tas., *A.J.Brown 157B* (MEL); Mayfield Beach, Tas., *A.J.Brown 15B5* (MEL); Kelvedon Beach, Tas., *A.J.Brown 1579* (MEL)
	2010-12	Kelvedon Beach, Tas., *A.J.Brown 1579* (MEL)
L. punicea* subsp. *punicea	2002-03	Dartmoor, Vic., *A.J.Brown 1511* (MEL), *A.J.Brown 2175* (MEL); South Bulart, Vic., *A.J.Brown 2523* (MEL)
	2010-12	Dartmoor, Vic., *A.J.Brown 2175* (MEL); South Bulart, Vic., *Brown A.J. 2523* (MEL)
L. punicea* subsp. *filifolia	2002-03	South Bulart, Vic., *A.J.Brown, 1270* (MEL)
	2010-12	South Bulart, Vic., *A.J.Brown, 1270* (MEL)

Figure 1: *Lochnogrostis robusta*: **a** tussock x0.3, **b** spikelets x5, **c** anther x10, **d** floret, lateral view x10 (detail x20), **e** floret, dorsal view x10 (*A.J.Brown 1149* MEL2133221). *L. puniceo* subsp. *punicea*: **f** floret, lateral view x10 (*A.J.Brown 1047* MEL2131439). *L. puniceo* subsp. *filifolio*: **g** floret, lateral view x10, **h** anther x10, **i** tussock x0.3, **j** spikelets x5 (*A.J.Brown 1473* MEL2125359).

***Selected specimens exomined*: SOUTH AUSTRALIA:** Todd River, Eyre Peninsula, 9.xii.1968, *C.R.Alcock 2605* (AD); Lake Kitty, Kangaroo Island, iv.2000, *R.J.Botes s.n.* (AD); Murray Lagoon, Kangaroo Island, 15.iv.2000, *R.J.Botes 561B6* (AD); Eudunda Creek, 12.ii.2000, *R.J.Botes 55B96* (AD); 3km E of Rockleigh, 26.ii.2003, *D.E.Murfet 4320* (AD); 5km NE of Saddleworth, 30.xii.2003, *R.J.Botes 62040* (AD); Creek near Marrobel, 16.ii.2005, *R.J.Botes 6477B* (AD); Pondalowie Firetrack (Innes National Park), Yorke Peninsula, 30.v.2006, *T.Joques INP21B & T.Lewis* (AD); Murraytown, 13.xii.2007, *R.J.Botes 76203* (MEL), Limy Creek (Mt Remarkable National Park), 13.xii.2007, *R.J.Botes 76244* (MEL); Bundaleer Reservoir, 16.i.2008, *R.J.Botes 76B95* (AD); Koonoona Station, 16.i.2008, *R.J.Botes 76727* (AD); Goodnadigby, 17.i.2008, *R.J.Botes 76B96* (AD); Magpie Creek, E of Brinkworth, 17.i.2008, *R.J.Botes 76B97* (AD); **VICTORIA:** Norval, 24.xii.2003, *A.J.Brown 2341* (MEL); Telfers Swamp, 17.xi.2004, *A.J.Brown 1760* (MEL); North Lake, 31.i.2003, *A.J.Brown 2346* (MEL).

***Correction to Brown and Walsh (2000)*, p. 83:** Skipton, 11.i.1994, *Brown 870* (MEL) should be *Brown 863*.

Lachnagrostis billardierei subsp. *billardierei*

Of particular interest are those new populations that occur well inland from the normal SW Victoria or SE South Australia coastal habitat of this taxon. A number of the new sites are on ephemeral lakes and swamps associated with dune systems stranded by the Mid-Pleistocene coastline regression of the ancient epeiric Murray Basin. However, whether *L. billardierei* is part of a remnant vegetation or a more recent invasion to these sites, is not known. The taxon also occurs sporadically along spring-fed creek lines and gorges of the Lofty Ranges and the Lower Glenelg River, where these relatively protected and continuously watered environments can produce large tussocks with very large panicles. In some environments, such as in *Leptospermum lanigerum* (Sol. ex Aiton) Sm. swamp, culms may be rather long and straggling and leaves more flaccid than usual. Fig. 2a-e.

***Selected specimens examined*: SOUTH AUSTRALIA:** Eerie Swamp, Comaum, 8.xii.1990, *K.Alcock 62* (MEL); Rockleigh, 26.ii.2003, *D.E.Murfet. 4319* (AD); Brady Creek, i.xi.2003, *L.M.B.Heord BS1621160 & N.R.Neogle* (AD); Glenburnie Gorge, xi.2003, *R.J.Botes 619B3* (AD); Saddleworth, 30.xii. 2003, *A.J.Brown 1741* (MEL); Rhynie, 30.xii.2003, *A.J.Brown 1742* (MEL); Yakilo Water Reserve, 4.xi.2004, *J.Turner BS1623442 & A.Brown* (AD); Logan Morass, xi.2005, *R.J.Botes 66916* (AD); Tarlee, 2.xii, 2005, *P.J.Ainsley104 & A.Clorke* (AD); Noolook Forest Reserve, 2.xi.2007, *R.J.Botes 75796* (MEL). **VICTORIA:** Wanwin Falls, Dartmoor, i.2001, *R.J.Bates 5B031* (AD); Mitre Lake, 11.xii.2002, *A.J.Brown 232B* (MEL); Tooan Lake, 12.xii.2002, *A.J.Brown 2334* (MEL); White Lake, 31.i.2003, *A.J.Brown 2332* (MEL); North Lake, 31.i.2003, *A.J.Brown 2333* (MEL); Skipton, 23.xii.2003, *A.J.Brown 1740* (MEL); Ararat, 1.xii,2004, *A.J.Brown 1743* (MEL); Salt Creek, Poolaigelo, 18.i.2006, *A.J.Brown 1744* (MEL).

***Correction to Brown and Walsh (2000)*, p. 80:** St. Marnock's Swamp, Crossroads, south of Eurambeen, 4.i.1996, *Brown 1117* (MEL) should be *Brown 1118*.

Lachnagrostis billardierei subsp. *tenuiseta*

No new populations of this taxon have been recorded for Tasmania since 2000. However, examination of New Zealand specimens of *L. billardierei* has revealed a number of collections with very short, straight awns, reminiscent of subsp. *tenuiseta*; a taxon not formerly recorded in that country. A few on-loan collections of New Zealand material were available for measurement of vegetative and floret characters (Table 2) and these show that at least some New Zealand specimens of subsp. *billardierei* are comparable in leaf size to the Australian plants (as given by Brown and Walsh 2000), while spikelet and floret size are at the upper end of the Australian range. Comparisons between Australian subsp. *tenuiseta* and the New Zealand apparent subsp. *tenuiseta* specimens show similar features, except that the reduced lemma awns on the New Zealand material are attached near the mid-back point (43-59% of the lemma length, from the base), while the Australian examples have awns attached at 69% of the lemma length or higher. The Australian plants have lemma awns (where present) that are always fine and bristle-like, generally extending beyond the lemma tip. Only one of the New Zealand examples (Taumataraea, *de Lange 6109 & Gardner*) examined had a bristle-like lemma awn but unlike the Australian plants, this appeared to be readily deciduous from a minute basal attachment. The other New Zealand examples had, when present at all (including on lemmas fully enclosed by the glumes), what appeared to be, a much reduced and tightly appressed, awn column only. Two of the apparent subsp. *tenuiseta* collections provide habitats as "open dunes with marram grass" and "dune vegetation at rear of beach" while the New Zealand collections of subsp. *billardierei* derive from "rock-soil interface above high tide level" and "rock crevice above beach". These habitat

Figure 2: *Lachnagrostis billardierei* subsp. *billardierei*: **a** partial mature tussock x0.3, **b** partial mature tussock with emerging inflorescences x0.3, **c** spikelet x10, **d** anther x10, **e** floret, lateral view x10 (*A.J.Brown 1526* MEL2133133). *Lachnagrostis billardierei* subsp. *tenuiseta*: **f** spikelet x10, **g** anther x10, **h** floret, lateral view x10, **i** tiller with maturing inflorescence (*A.J.Brown 15B5* MEL2133144).

Table 2. Ranges of some morphological characters for *L. billordierei* ssp. from Australia and New Zealand.

Character	ssp. *billardierei* Australia	ssp. *billardierei* New Zealand	ssp. *tenuiseta* Australia	appar. ssp. *tenuiseta* New Zealand
No. collections examined	26	2	7	3
Flag leaf width, mm	2-8	3-4.5	1.5-4	1.5-2
Flag leaf length, mm	4.5-27	10-11	5-12	7.5-12.5
Spikelet gape[1]	1-4	3-4	1-2	2-4
Lower glume length, mm	3.1-6.7	5.2-5.8	4.4-5.7	4.6-5
Lemma length, mm	2.4-4.3	3.5-4.5	2.9-3.3	2.8-3.5
Lemma setae length, mm	0.1-1	0.6-0.8	0-0.2	0.2-0.3
Palea length, mm	1.7-2.9	2.2-3	2.1-2.5	2.0-2.5
Rachilla extension, mm	1.7-3	2.7-3.4	2-3	1.8-2.5
Awn length, mm	3.6-9	5.4-8.3	0-1.9	0.3-1.5
Awn attachment, % of lemma	29-47	38-39	69-94	43-59
Anther length, mm	0.5-1	0.7-1	0.5-0.8	0.6-0.7

[1] score: 1 = nil or scarely gaping outer glumes, 2 = slightly gaping outer glumes (up to 10°), 3 = moderately gaping outer glumes (10° to 30°), 4 = widely gaping outer glumes (>30°).

differences are not dissimilar to the Australian habitats for subsp. *tenuiseta* and subsp. *billardierei* (Brown and Walsh 2000). Despite this similarity, the morphological evidence suggests a (at least one) separate genesis for these New Zealand specimens, apart from the Australian subsp. *tenuiseta*. Further and broader examination of both morphological and genetic features of these entities would be needed to resolve their relationship. Fig. 2f-i.

***Specimens examined*: AUSTRALIA:** see Brown and Walsh 2000. **NEW ZEALAND:** *Lochnogrostis billordierei* subsp. *billordierei*: Kahangaroiti, Cavalli Islands, 30.xii.1978, *A.E.Wright 2B96* (AK); Panaki Island, Cavalli Island Group, 5.i.1979, *A.E.Wright 3067* (AK). *Lachnagrostis billardierei* apparent subsp. *tenuiseto*: Taumataraea Point, Laington, 14.iv.2004, *P.J.de Longe 6109 & R.O.Gordner* (AK); Ngungura Bay, 23.xi.2000, *W.Porr s.n.* (AK); Uretiti Beach, S of Ruakaka, 17.xi.1992, *M.L.Fromont s.n.* (AK).

Lachnagrostis punicea subsp. *punicea*

Prior to 2000, the majority of collections had been made in Victoria (Brown and Walsh 2000). With only three previous collections of this taxon known from South Australia, new collections made in the South-east since 2000 have consolidated its occurrence in that region of the State. Some additional collections in Victoria were made on the periphery of the known distribution. Fig 1f.

***Selected specimens examined*: SOUTH AUSTRALIA:** Brim Swamp, 29.xi.2004, *D.E.Murfet 4B10* (AD); Honans Forest Reserve, Glencoe, iii.2005, *R.J.Botes 65001* (AD); Whennans Native Forest Reserve, Mt Burr, i.2006, *R.J.Botes 67652* (AD); Near Lake Beachport, 18.i.2006, *R.J.Botes 67673* (AD); Penola Conservation Park, 20.xii.2007, *R.J.Bates 7634B & A.J.Brown* (AD); McRostie Native Forest Reserve, 21.xii.2007, *R.J.Botes 76704 & A.J.Brown* (AD). **VICTORIA:** Norval, 24.xii.2003, *A.J.Brown 2338* (MEL); Glenisla, 7.xii.2005, *A.J.Brown 2294* (MEL); Lake Mundi, 17.i.2006, *A.J.Brown 2297* (MEL); Dergholm, 19.ii.2008, *A.J.Brown 2042* (MEL); Dartmoor, 7.i.2009, *A.J.Brown* 2175 (MEL).

Correction to Brown and Walsh (2000), p. 85: Digby, 3.xii.1998, *Brown 1512* (MEL) should be *Brown 1511*.

Lachnagrostis punicea subsp. *filifolia*

A few new collections were made in south-east South Australia. Unlike in Victoria, mixed populations of the two subspecies of *L. punicea* are yet to be found in South Australia. Fig 1g-j.

***Selected specimens examined*: SOUTH AUSTRALIA:** East Avenue, 100m E of Murrangombah turnoff 20.xi.2007, *R.J.Bates 757B7* (MEL); East Avenue, 50m E of Lenunga Homestead gate, 20.xi.2007, *R.J.Bates 75BB9 (AD)*; Salt Well Road, between Highway and Cape Jaffa, 22.xi.2007, *R.J.Bates 75724* (MEL); Mary Seymour Conservation Park, 20.xii.2007, *R.J.Bates 76327 & A.J.Brown* (AD); **VICTORIA:** Glenisla Crossing, 7.xii.2005, *A.J.Brown 2295* (MEL).

Correction to Brown and Walsh (2000), p. 86: Lake Goldsmith, Stockyard Hill, 6.xii.1998, *Brown 1189* (MEL) should be *Brown 1180*.

2001-03 pot trials

A comparison of the five accessions of *L. robusta* (Table 3) shows little difference between them in most characters, except that the Salt Swamp accession was slightly taller at the first measurement (8 weeks post sowing), mean leaf width was slightly greater in the early part of the season, the onset of flowering was delayed by 1-2 weeks and overall inflorescence numbers were lower (e.g. 54% lower than the next lowest; Lake Linlithgow, at 20 weeks post sowing). In late winter, between the growing seasons, the Skipton accession showed the least mean green leaf and the lowest mean dry inflorescence retention, though values varied widely across replicates (Table 3).

In the following season, onset of flowering was some 8 weeks earlier than for the previous season, except for the Salt Swamp accession which was only 2 weeks earlier. Second year inflorescence numbers were lower than first year results for all accessions, ranging from 31% less for Carranballac to 94% less for Salt Swamp, and flowering had finished by the end of January.

Onset of flowering in *L. robusta* was generally later by 3 weeks than *L. punicea*, was straddled by flowering time in *L. billardierei* subsp. *billardierei* and was 1-4 weeks earlier than for *L. billardierei* subsp. *tenuiseta*. Except for the Carranballac accession of *L. robusta*, plants of *L. billardierei* subsp. *billardierei* produced the highest inflorescences numbers (from 37-46 per plant). Overall, plants of *L. billardierei* subsp. *tenuiseta* produced the lowest number of inflorescences, with the Dolphin Sands and Kelvedon Beach accessions producing means of 4 and 5 inflorescences per plant only and

Table 3. Means and ranges in plant measurements for *Lochnogrostis robusto* accessions grown under outdoor conditions in the 2001-2002 growing season.

Measurement	Salt Swamp	Willaura	Lk Linlithgow	Skipton	Carranballac
8 weeks post sowing (21 November 2001)					
Tussock height, cm	33 (30-35)	29 (22-32)	26 (21-30)	26 (23-31)	23 (20-25)
No. of tillers	10 (6-13)	10 (7-13)	11(7-19)	9 (6-12)	9 (8-11)
Leaf width, mm	2.8 (2.5-3.0)	2.1 (1.5-2.5)	1.9 (1.5-2.5)	2.0 (2.0-2.5)	1.8 (1.5-2.0)
Leaf inroll score[1]	0.3	0.5	0.5	0.7	0.6
12 weeks post sowing (19 December 2001)					
Tussock height, cm	36 (27-44)	31 (26-34)	30 (26-35)	30 (25-35)	25 (21-31)
Leaf width, mm	5.4 (4.5-6.0)	4.3 (3.0-7.0)	4.4 (3.5-5.0)	4.5 (4.0-5.0)	3.7 (3.0-4.5)
Leaf inroll score[1]	0.7	0.7	0.5	0.5	0.6
14 weeks post sowing (3 January 2002)					
Tussock height, cm	34 (30-43)	34 (30-39)	37 (34-40)	32 (28-36)	31 (25-35)
Leaf width, mm	5.0 (4.0-6.0)	4.5 (3.5-5.5)	4.7 (4.0-5.5)	4.3 (3.5-5.0)	4.6 (4.0-5.0)
Leaf inroll score[1]	0.8	0.8	0.9	0.8	0.6
Emergence of 1st inflorescence, weeks post sowing	19	18	17	17	17
20 weeks post sowing (13 February 2002)					
Overall plant height, (incl. inflores), cm	53 (51-56)	50 (49-53)	55 (52-59)	50 (48-51)	51 (48-53)
Leaf width, mm	3.9 (2.5-5.5)	3.9 (3.5-4.5)	3.6 (3.5-4.0)	3.4 (3.0-3.5)	4.3 (4.0-4.5)
Leaf inroll score[1]	1.0	1.3	1.0	1.0	2.0
Inflorescence (green) number per plant	18 (3-29)	48 (38-56)	39 (21-50)	53 (39-69)	52 (41-64)
22 weeks post sowing (6 March 2002)					
Inflorescence (green) number per pot	49 (31-60)	72 (62-81)	68 (52-79)	65 (44-93)	78 (68-87)
No. disarticulated inflorescences	none	many	few	many	many
11 months post sowing (14 August 2002)					
Green leaf, % of tussock	23 (20-30)	33 (20-40)	20 (1-30)	8 (1-20)	38 (30-40)
Leaf inroll score[1]	3.0	3.0	3.0	3.0	3.0
Inflorescence (dry) number per plant	9 (5-15)	13 (9-20)	19 (13-25)	4 (2-9)	12 (6-16)
Second season (January 2003)					
Inflorescence (green) number per live plant	5 (3-7)	18 (11-33)	28 (21-34)	10 (0-17)	54 (42-64)

[1] mean values for leaf inrolling; scored as: nil =0, very slight = 0.5, slight = 1, moderate = 2, full = 3

the Mayfield Beach accession producing a mean of 18. Mean inflorescence numbers for *L. robusta* and *L. punicea* (combined subspp.) were similar at 23 and 28 respectively.

2010-12 pot trials

Plants grown under shade-house conditions were either taller or longer or both than those grown outside (Table 4). Shade-house plants of *L. robusta* and *L. punicea* in particular grew very long over time, lodging to form long trailing culms with entangled inflorescences that generally failed to disarticulate when mature. Although also growing rather lanky culms, inflorescences of *L. billardierei* retained their ability to maintain separateness and readily disarticulate. Leaf width was also increased under shade-house conditions compared to outdoor. Leaves of *L. billardierei* remained flat under both conditions, while leaves of most, though not all, outdoor plants of *L. robusta* and *L. punicea* had a tendency to inroll, even if not strongly.

Discussion

Although the data presented in this paper is an amalgamation of a series of potted growth studies and is therefore not consistent in methodology, some overall comments can still be made.

Lachnagrostis robusta

The slight but noticeable differences in vegetative size and the onset of flowering between the *L. robusta* accession from Salt Swamp and the other accessions (Table 3) may be due to its more south-easterly and near-coastal location (5 km NW of Barwon Heads and part of the Lake Connewarre and Barwon River wetland complex). The other populations of *L. robusta* in the 2001–02 trial, derived from inland ephemeral salt lake or swamp sites in the Western District of Victoria, where plants are likely to be adapted to more sporadic soil moisture content, slightly higher summer temperatures and shorter seasons. Brown and Walsh (2000) provided means for 75 *L. robusta* field-collected herbarium specimens from across SE Australia, of 48 cm, 27 cm and 0.6 mm for overall height, tussock height and leaf width, respectively. The height measurements are comparable to those measured in the 2001–02 trial (Table 3) and the 2011–12 outdoor trial (Table 4) but leaf width is considerably narrower. The normal field condition for *L. robusta* is to have inrolled leaves (Brown and Walsh 2000), presumably as a consequence of the stress imposed by its saline (and therefore moisture stressed) habitat. In all the pot trials, the plants were free of salt stress and hence leaf inrolling was not readily expressed. In the 2001–02 trial, leaf rolling was generally nil to very slight at the start of the season and became slight to moderate as summer proceeded. Not until the end of the following winter, when the pots were root-bound, did the leaves display their typical full inrolling character. In the one example of *L. robusta* (Carranballac) grown under shade-house conditions (Table 4), the leaves were completely flat and somewhat wider than for the outdoor example. The lank and lodged growth with entangled inflorescences observed under shade-house conditions would never be found in the field where the species always grows in open, non-shaded conditions, even if growing around and through *Juncus* and *Gahnia* tussocks. The reduction in inflorescence numbers between the first and second year plants of the 2001–03 seasons (Table 3) is likely to reflect some moisture and nutrient limitations due to the root bound conditions imposed by not dividing and repotting the plants; limitations not expected to be found in the field except during drought conditions.

Lachnagrostis billardierei

As for *L. robusta*, shade-house conditions produced greater plant size and wider leaves than outdoor conditions in *L. billardierei* (Table 4), although, except for plant length, differences in subsp. *tenuiseta* were not as pronounced as for subsp. *billardierei*. With the exception of the Mitre Lake accession, subsp. *tenuiseta* produced greater plant size (height and length, though probably not bulk) in outdoor conditions than subsp. *billardierei*. The low inforescence numbers (Table 3) of this subspecies may be indicative of its rarity and narrow distribution in the wild. Preliminary analysis of RAPD's data suggested that subsp. *tenuiseta* may be apomictic in nature (*pers com.* E.A. James).

Lachnagrostis punicea

Culm-lodging, lack of leaf-inrolling or folding and inflorescence entanglement were also features of

Table 4. Plant size, leaf width and leaf condition for accessions of *Lachnagrostis* taxa grown under shade-house conditions in the 2010-2011 growing season and under outdoor conditions in the 2011-12 season.

Taxon	Accession	Nursery conditions	Plant height, cm	Max. plant length, cm	Max. leaf width, mm
L. robusta	Lake Linlithgow	outdoor	32	32	2.0[a], 3.0[b]
	Carranballac	shade-house	30	65	5.5[b]
		outdoor	32	32	1.5[a], 3.0[b]
	Wingeel	outdoor	32	32	1.5[a], 2.5[b]
	Telfers Swamp	outdoor	30	30	3.0[a], 4.0[b]
	Holm Hill	outdoor	45	45	3.0[b]
	Lenunga	outdoor	31	31	3.5[b]
L. billardierei* subsp. *billardierei	St Marnocks	outdoor	11	18	8.0[b]
	Tilley Swamp	shade-house	36	55	10.0[b]
		outdoor	12	20	5.0[b]
	Reedy Creek	shade-house	33	42	9.0[b]
	Piccaninnie Ponds	outdoor	12	24	7.0[b]
	Mitre Lake	outdoor	22	25	6.0[b]
	Emita Beach	outdoor	11	11	6.0[b]
L. billardierei* subsp. *tenuiseta	Kelvedon Beach	shade-house	25	51	6.5[b]
		outdoor	22	30	6.0[b]
L. punicea* subsp. *punicea	Dartmoor	shade-house	28	56	3.5[b]
		outdoor	18	30	3.5[b]
	South Bulart	outdoor	23	26	1.5[a], 3.0[b]
L. punicea* subsp. *filifolia	South Bulart	shade-house	24	51	3.0[b]
		outdoor	19	32	1.5[a], 3.0[b]

[a] inrolled or folded, [b] flat – note: where both leaf conditions are listed, partially inrolled leaves were hand-flattened to obtain a flat measure.

L. punicea under shade-house conditions as they were for *L. robusta*. There were no discernible differences in vegetative growth or inflorescence production between the subspecies of *L. punicea*, which suggests that, the major, and perhaps only, genetically based difference between them (lemma hairiness) is controlled by a single gene.

Growing conditions can obviously have important influences on the growth habit and phenology of these *Lachnagrostis* taxa. Phenotypic plasticity needs to be understood before differences, observed between field populations of the same species, promote the potential false establishment of new subspecies or varieties. Where species may be taken out of their natural environments for use in agricultural or nursery pursuits, it might well be expected that character change will occur and those features for which the plant was initially selected may not be maintained

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References

Brown, A.J. and Walsh, N.G. (2000). A revision of *Agrostis billardierei* R.Br. (Poaceae). *Muelleria* **14**, 65-90.

Jacobs, S.W.L. (2001). The genus *Lachnagrostis* (Gramineae) in Australia. *Telopea* **9(3)**, 439-448.

Jacobs, S.W.L. (2002). Corrections to and a new combination in *Lachnagrostis* (Gramineae). *Telopea* **9(4)**, 837-838.

Jacobs, S.W.L. (2004). A new combination in *Lachnagrostis* (Gramineae). *Telopea* **10(4)**, 840.

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Allan, H.H. (1961). *Flora of New Zealand.* R.E. Owen, Government Printer: Wellington.

Ahti, T. and Kashiwadani, H. (1984). 'The lichen genera *Cladia, Cladina* and *Cladonia* in southern Chile'. In H. Inoue (ed.), *Studies on the cryptogams of southern Chile*, pp. 125–149. Kenseisha Ltd: Tokyo.

Brummitt, R.K. and Powell, C.E. (1992). *Authors of plant names.* Royal Botanic Gardens: Kew.

Jarman, S.J. (1975). *Experimental taxonomy on the family Epacridaceae.* PhD thesis, The University of Tasmania, Hobart: Tasmania.

Pickett, J.W., Smith, N., Bishop, P.M., Hill, R.S., Macphail, M.K. and Holmes, W.B.K. (1990). A stratigraphic evaluation of Ettingshausen's New England Tertiary plant localities. *Australian Journal of Earth Sciences* **37**, 293–303.

Swofford, D.L. (2000). *PAUP. Phylogenetic analysis using parsimony (version 3.1.1.)* Illinois Natural History Survey: Champaign, USA.

Walsh, N.G. (1994). 'Poaceae'. In N.G. Walsh and T.J. Entwisle (eds), *Flora of Victoria*, **Vol. 2**, pp. 356-627. Inkata Press: Melbourne.

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